DOCUMENT RESUME

ED 037 985 EF 004 197

TITLE	A Study of Utilization, Design and Cost of Secondary Schools. Report to the Minister of Education and Cultural Affairs, Government of Ceylon.
INSTITUTION	Asian Regional Inst. for School Building Research, Colombo (Ceylon).
REPORT NO	Study-9
PUB DATE	69
NOTE	108p.
AVAILABLE FROM	Asian Regional Institute for School Building Research, Box 1368, Colombo, Ceylon
EDRS PRICE	EDRS Price MF-$0.50 HC Not Available from EDRS.
DESCRIPTORS	*Construction Costs, Facility Utilization Research, *School Buildings, *School Construction, *School Design, School Planning, *Secondary Schools

ABSTRACT

An introductory section includes information regarding the background and educational aspects of the study, and the collection and analysis of data. Consideration is then given to--(1) various factors affecting the cost of school buildings in Ceylon, and (2) standard building plans. The report shows how the cost of buildings for education in Ceylon can be substantially reduced, and suggests ways in which amenity can be improved for both children and teachers. (FS)

CEYLON

EF 004 197

Asian Regional Institute for School Building Research
Sponsored by Unesco

ED0 37985

STUDY
9

A study of UTILIZATION, DESIGN and COST of SECONDARY SCHOOLS

Report to the
Minister of Education and
Cultural Affairs
Government of Ceylon

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PREFACE

Since early 1965, the three Unesco-sponsored school building research institutes in Africa, Asia and Latin-America have been engaged in a collaborative effort to investigate the costs of second-level school building in their regions. Standard methods have been devised for the collection of data and eventually, when these methods have been checked in the field, it will be possible to collect and publish material on school building costs, arranged in such a way that useful comparisons can be drawn between one country and another and suitable ideas and techniques shared between all countries in which the studies are made.

Ceylon is one country in which, through the co-operation of the Ministry of Education, the standard method of collecting cost- and other data has been checked. A report giving the Institute's views on the standard method will be submitted to an international meeting of the Directors and experts from each of the school building institutes to be held in Colombo in October 1967. By that time, Asian Regional Institute experts will have made further checks on the suitability of the data collection method in Iran, Afghanistan and India.

However, the international cost study is a long term project from which results cannot be expected for some considerable time. What is needed in Ceylon, as indeed in other States, is some immediate action in the matter of reducing the cost and improving the amenity of the Nation's schools. The data collected as part of the Ceylon cost study can thus be put to two uses: firstly, it forms the basis of this action report on the utilisation, design and costs of second-level schools in Ceylon and secondly, it will ultimately form part of the larger, international study through which Ceylon may learn from the school building experiences of other countries and the other countries of the Region may learn from the experiences of Ceylon.

A study such as has been recently made in Colombo and in several regions of Ceylon relies for its success on the kindness of busy officials who despite the pressure of work, make time to assist in the provision of data and to participate in the frequent and lengthy discussions that are vital if the school building situation is to be fully explored. In this connection, special mention must be made of the Superintending Engineer of School Works Mr.W.R.A.D.B.Ratnayake, who has provided the drawings and cost data on which the study is based and who has on many occasions given advice and assistance without which it would have been difficult to proceed. The field studies were made possible through the kindness and collaboration of the Directors of Education of the following regions:

Colombo
Kandy
Nuwara Eliya
Bandarawella
and Jaffna.

Apart from these people, considerable data has been made available by the School Works Engineer and his staff of the Colombo region. We offer them our thanks.

Appreciation must be expressed for the kindness and tolerance of the headmistress and the ten headmasters whose schools formed the basis for the detailed field work. In each of these schools three or four of the Institute's staff spent a day during which the organisation and costing of each school was investigated in considerable depth.

In every case the fullest assistance was afforded by the responsible head of the school and many continued to supply supplementary data long after the Institute's team had left.

Finally, we would like to express our appreciation of the assistance given by the following gentlemen: Mr.A.S.Kulasinghe, Chairman of the State Engineering Corporation; the Conservator of Forests and his assistants; the Chief Architect of the P.W.D. and by the participants of the Seminar on secondary school buildings in Ceylon for their contributions.

SUMMARY

This report has two objects. First, it shows how the cost of buildings for education in Ceylon can be substantially reduced and, secondly, it suggests ways in which educational amenity can be improved for both children and teachers.

The first step that has to be taken to achieve cost reductions is to ensure that there is in fact a need for every new building that is constructed. We have found in some schools, that an over-provision of teachers has resulted in an unnecessarily large number of small teaching groups with a consequent and artificially created need for more teaching accommodation. *It is recommended that, in future, before a new building is sanctioned, for an existing school, a check be made of the gross area of existing accommodation which should not be greater than 32 square feet per place, based on the average attendance*. Where a school has less than 32 square feet of area per pupil place then the new construction sanctioned should be such as to bring the gross area of the school up to this standard. This measure will prevent waste of money on unnecessary building.

The next step is to ensure where the construction of new units takes place that the type of unit built is suitable, having regard to the teaching programme. We have seen schools in which laboratories were needed but assembly halls were requested and schools already having good laboratories, building more, when in fact there was no library and no provision for staff.

There is a need, the report suggests, for a simple publication for the guidance of principals on programming and accommodation. Short seminars should also be conducted on this aspect of administration.

Ministry officials who have attended the courses at the Asian Regional Institute for Educational Planning and Administration at New Delhi are well qualified to advise and assist in this work which has a direct bearing on the way in which money for school buildings is spent. *It is recommended that an official be sent to the Delhi course which now offers "buildings" as an elective subject*. This officer could then, on return from such a course be assigned duties connected with implementation of the foregoing.

The design, construction, maintenance and thus the cost of school building in Ceylon depend on the operations of the School Works Branch of the Ministry of Education and Cultural Affairs. In 1966/67 the cost of this branch was about 1.3% of the value of work it undertook. In 1967/68, the cost of the branch will be reduced to about 0.7% of the capital works budget. This is woefully low compared with 11% in a number of other countries, and confirms what we have observed: that the School Works Branch with its present staff, is quite unable to handle the great burden of construction work resulting from developments in Ceylon's educational patterns. This statement in no way reflects on the staff of the branch. Indeed it is only through skilful deployment of conscientious staff and through the use of standard plans that 60% of the capital budget for 1966/67 was consumed. It may be confidently predicted for the future however that the Branch, as at present staffed, will be quite unable to handle the greatly increased volume of building resulting from a budget twice as large as that for 1966/67 and, moreover, involving the construction of buildings such as junior universities and other vocational schools for which the existing standard plans are quite unsuitable.

It is recommended that steps be taken most urgently to increase the size of the design staff of the School Works Branch and actively to implement a training programme for architectural and quantity surveying staff. Assistance of U.N. and its agencies should be sought meanwhile for the provision of professionally qualified staff to tide over the difficult period that will follow whilst suitable local staff are being trained.

Many of the very considerable economies in educational building that can be achieved are based on the assumption that more money is spent on design and supervision. It is necessary to invest only a little in order to reap the benefits of big savings in expenditure.

As far as the detailed operations of the School Works Branch are concerned, we believe that present tendering procedures could be adjusted to take advantage of the very considerable programme of repetitive building in which the Ministry is engaged. It is now well established that unit costs for contracts for a series of buildings are likely to be substantially lower than those for a single contract.

Moreover only one set of drawings and one set of contract documents are required for the entire series. This substantially reduces the burden of contract preparation in the School Works Branch - an important factor in view of the comments made above.

It is recommended that the Ministry offer for tender, series of school buildings, the successful contractor being required on his part to build all schools in the series, wherever they be located, for the same unit prices as he quotes for the first school of the series and subject to satisfaction with his performance in constructing the first school.

Ceylon now has over 9,000 schools. Each school comprises a number of separate standard units. The total number of individual buildings is thus certainly well in excess of 40,000. The total annual budget for maintenance was Rs.5 million in 1965/66 and this was reduced to Rs.4 million in 1966/67 despite increases in the size and age of the stock of schools. That represents a maximum of Rs.100 per building for annual maintenance. The cost of internal and external decoration of the smallest standard unit once every five years would be Rs.98.20. Assuming no other maintenance is necessary (and such is most unlikely), it will be seen that the provision for keeping the Nation's stock of schools in a state of reasonable repair is wholly inadequate. This statement is fully borne out by the field inspection we have made of a sample of schools. The rate of increase of construction of new schools is now dropping off as the rate of increase of the school-going population reduces. It is recommended therefore, that there be a sharp increase in future budgets for maintenance, that the School Works Branch be augmented in the field and that regular maintenance surveying and supervision be included in the duties of school works inspectors and sub-inspectors.

The standard designs that are used for the construction of new units of accommodation can be both cheapened and improved. Suggested new designs are included in the report. It is recommended that these new designs be used in the interim period whilst design staff are being recruited for the School Works Branch. Page 40 of this Report shows the reductions in unit costs that can be achieved if this is done. For a budget of Rs.41 million the saving could be of the order of Rs.5 million.

Finally, it is recommended that educationists be more closely connected with the detailed design of Ceylon's secondary schools. This can best be achieved through development groups of the sort that has already started work on vocational school buildings in Colombo. Development groups will not only produce cheaper units of accommodation but units that are more precisely tailored to the over-riding needs of the educationists and the children.

Résumé.

Le présent rapport a deux objectifs. En premier lieu il indique comment le coût des constructions scolaires à Ceylan peut être réduit, et en second il fait des propositions quant à l'amélioration des installations scolaires et de l'équipement destiné à l'enseignement, tant en ce qui concerne celui qui est prévu à l'usage du personnel enseignant que celui qui a été installé à l'intention des élèves.

La première mesure à adopter pour réaliser une réduction des coûts est l'examen de la nécessité quant à la construction de chaque nouveau bâtiment scolaire. Dans quelques écoles nous avons trouvé que, afin d'occuper tous les enseignants (qui étaient beaucoup trop nombreux), les élèves avaient été répartis en petits groupes qui, à leur tour, créaient la nécessité, plutôt artificielle, de prévoir des locaux supplémentaires. On recommande alors que, à l'avenir, on étudie la superficie brute des bâtiments existants avant de permettre la construction de bâtiments supplémentaires. Calculée sur la base de la fréquentation scolaire moyenne, la superficie brute ne doit pas excéder 32 pieds carrés par place.

Dans le cas où une école comprend moins de 32 pieds carrés de superficie par élève, il importe que le plan d'un nouveau bâtiment soit élaboré de façon que, après la construction du bâtiment, la superficie brute de l'école entière comprenne 32 pieds carrés par élève. L'application de cette mesure empêche tout gaspillage de ressources financières dans le domaine de la construction scolaire.

Ensuite il faut s'assurer que les locaux et les unités scolaires à construire soient en conformité avec les exigences du programme scolaire. Nous avons visité des écoles qui, bien qu'elles eussent besoin de laboratoires, demandaient des salles de réunion. Il y en avait d'autres qui, possédant déjà de bons laboratoires, en demandaient davantage, bien qu'il n'y eût ni bibliothèque ni salle commune pour le personnel enseignant.

Le rapport recommande la publication d'un "guide" comprenant les principes de la programmation et de la répartition des locaux. De plus, il faudrait organiser des séminaires au cours desquels ces problèmes seraient abordés.

Les fonctionnaires ministériels qui ont participé aux cours de l'Institut régional asiatique de Planification et d'Administration, New Delhi, ont toutes les qualifications nécessaires pour conseiller et aider ce travail qui exerce une influence directe sur la manière selon laquelle les ressources allouées aux constructions scolaires sont utilisées. A cet égard, on recommande qu'un responsable du cadre dirigeant soit délégué de participer aux cours à New Delhi, où "Construction" est offert comme sujet facultatif. Après son retour, ce fonctionnaire pourrait être chargé des fonctions se rapportant à la réalisation de ce que nous venons de mentionner plus haut.

La conception, la construction et l'entretien et, en conséquence, le coût de la construction scolaire à Ceylan, dépendent des actions du "Service des Travaux scolaires" qui est institué au sein du Ministère de l'Education et de la Culture. En 1966/67, les frais d'entretien de ce service s'élevaient à environ 1,3 % de la valeur de tous les travaux effectués par lui. En 1967/68, les frais d'entretien seront réduits à environ 0,7 % du budget de tous les travaux en capital. En comparaison aux frais d'entretien dans grand nombre de pays, qui s'élèvent parfois à 11 %, il faut avouer que ces frais sont très modiques. Ce fait confirme ce qu'on a bien observé, c'est que ce service, tel qu'il existe, est absolument incapable de s'occuper de tous les travaux résultant de l'évolution de l'enseignement à Ceylan. Par cela on ne veut pas dire que le personnel ne soit pas compétent, en fait, ce n'est qu'en raison de la capacité et de l'esprit consciencieux du personnel responsable et parce qu'on a introduit l'utilisation de plans types, que 60 % des ressources en capital pour 1966/67 ont été utilisés. On peut pourtant prédire avec confiance que ce service, tant qu'il ne comprendra pas de personnel suffisant, sera absolument incapable de surveiller une construction qui sera tellement plus large et plus complexe à l'avenir. Il faut ajouter que, en plus, ce service sera chargé de la construction d'autres bâtiments, comme par exemple de collèges et d'écoles professionnelles, pour lesquels les plans types actuellement en usage sont absolument inadéquats.

Il est de grande urgence que le nombre d'architectes du "Service des Travaux scolaires" soit augmenté, et on recommande qu'on adopte immédiatement les mesures nécessaires pour faire ainsi. De plus, il faut organiser des cours de formation pour les architectes et les métreurs. Pour le moment, c'est-à-dire jusqu'à ce que le personnel nécessaire ait été formé, il faut demander aux Nations Unies de mettre à disposition le personnel qualifié nécessaire.

En dépensant davantage pour l'étude et la surveillance des travaux de construction, on espère pouvoir effectuer des économies considérables dans le domaine de la construction scolaire, et on est d'avis que l'investissement d'une petite somme à cet effet suffit pour réaliser d'importantes économies.

En ce qui concerne les procédés individuels du "Service des Travaux scolaires" nous aimerons bien souligner que la méthode actuelle des soumissions, par exemple, doit être modifiée et qu'il faut permettre la soumission pour un programme de constructions type répétées. On sait très bien que le coût d'une unité sur la base d'un contrat d'une série de constructions est moins élevé que celui sur la base de plusieurs contrats individuels. En outre, un tel système n'exige qu'une série de documents de soumission pour les constructions identiques et, en conséquence, le travail du "Service des Travaux scolaires", surtout en ce qui concerne la préparation de contrats, sera bien réduit.

On recommande alors que le Ministère appelle des soumissions pour des séries de constructions et qu'il demande à l'entrepreneur sélectionné de construire toutes les écoles qui appartiennent à la même série, en quelque lieu qu'elles soient construites, pour le même prix par unité qu'il a demandé pour la première école de la série et à condition que l'exécution des travaux de la première école soit satisfaisante.

A l'heure actuelle, Ceylan possède 9 000 écoles dont chacune comprend un certain nombre d' "unités types" séparées. Le nombre total de bâtiments individuels est bien au-dessus de 40 000. En 1965/66, les dépenses annuelles pour l'entretien de ces écoles s'élevaient à Rs. 5 million. En 1966/67, en dépit de l'accroissement du nombre de bâtiments scolaires, et en dépit du fait que les écoles étaient plus vieilles, ces frais étaient réduits à Rs. 4 million. Ce montant représente un maximum annuel de Rs. 100.- de frais d'entretien pour chaque bâtiment. Les frais pour la décoration intérieure et extérieure d'une des plus petites unités types s'élèveraient alors à Rs. 98.20 une fois tous les 5 ans. Sur la base qu'aucuns travaux d'entretien supplémentaires soient nécessaires, il faut admettre que pour maintenir les écoles en un état plus ou moins satisfaisant, le budget souscrit à l'entretien est absolument inadéquat.

Le taux d'accroissement de la construction de nouvelles écoles vient de subir une baisse. Ceci est dû au fait que l'accroissement de la population scolaire va également en ralentissement. On recommande donc qu'à l'avenir, les ressources financières allouées à l'entretien soient augmentées, que le "Service des Travaux scolaires" soit élargi et que les inspecteurs et les surveillants scolaires soient chargés d'examiner régulièrement les bâtiments et de surveiller les travaux effectués dans ce domaine.

Par une modification des plans types des "unités scolaires" on peut réaliser non seulement une réduction des coûts, mais aussi une meilleure conception. On recommande que jusqu'à ce que les architectes soient formés et rattachés au "Service des Travaux scolaires", on utilise les nouveaux plans types. Page 40 du rapport indique les réductions de coût que l'on peut réaliser de cette façon. Pour un budget de 41 million, les économies effectuées peuvent être de l'ordre de 5 million.

Pour finir on aimerait bien recommander que les éducateurs acquièrent une meilleure connaissance de tous les détails de la conception des écoles secondaires à Ceylan. La meilleure façon de réaliser ce but est au moyen de Groupes de développement, semblables à ceux qui ont déjà commencé à travailler aux constructions destinées à des écoles professionnelles à Colombo. Ces Groupes de développement concevront des unités scolaires qui coûteront moins cher et qui seront mieux adaptées aux exigences de l'éducateur et des enfants.

CHAPTER - 1

INTRODUCTION

1.01 Reason for the study

The cost of a school, the space and amenities provided, depend on the way in which the school is actually used. For example if a building is provided with classrooms each to seat 40 children and there are only 30 in some classes and 20 in others, then there is an obvious waste of space. Space costs money. Such a situation may develop due to a number of causes: there may be no designs for buildings with classrooms sized to house small teaching groups; in enlarging schools, there may have been an administrative failure to estimate correctly the number of children in the school's catchment area. Finally, there may be an over-provision of teachers resulting in unnecessary streaming into small groups. These and many similar factors bear on the decision to provide buildings of a particular type.

1.02 Background

Before the introduction of free education in Ceylon in 1945 secondary education of the type which led its recipients to recognised professions or trades or to posts in Government service was available in the English medium to the children of well-to-do parents, mostly in the urban areas. In the matter of educational organization, the curriculum and methods of teaching followed the traditions of English public schools. Little consideration was given to local needs, the future economic, industrial or agricultural development of the country, or indigenuous culture.

For those who were unable to pay fees there was secondary education in the swabasha schools which were ill-equipped and staffed by teachers who themselves had had little opportunity to receive a well rounded, broad-based education. The number of swabasha schools having secondary grades equivalent to present day IX and X Grades was very small. The highest profession to which the students of these schools could aspire was teaching in the very schools in which they themselves had been educated.

Introduction of free education in the English medium and the subsequent establishment of Government central and senior schools enabled a larger number of rural children to receive secondary education of the type previously available - mainly to children in the English schools. Though facilities for teaching of crafts formed a part of secondary education, establishment of institutions for practical education of the type envisaged in the Special Committee report, was not provided for, so that even with the opening of the central and senior schools, secondary education remained mainly academic and catered to the needs of a minority of the population of secondary school age.

With the progressive introduction of swabasha as the medium of instruction in secondary and higher education, the doors of secondary education were opened to a large percentage of those completing elementary education. More and more children are remaining in secondary general schools for the following reasons:

i. the general adoption of swabasha as the medium of instruction;

ii. the use of swabasha as the language of administration;

iii. establishment of two more universities;

iv. lack of employment;

v. absence of any programmes for vocational training;

vi. the take-over of the assisted schools. (See Tables I & II)

To meet the requirements of the increasing numbers of children demanding secondary education, many Maha Vidyalayas were instituted by either developing new sites or up-grading some of the large swabasha schools, which had classes up to Grade X.

TABLE I RISE IN ENROLMENT IN SECONDARY EDUCATION [1]

Year	VIII	IX - XII
1952	48,133	74,575
1956	65,164	138,540
1960	96,235	225,131
1962	119,067	274,932
1965	138,975	340,576
1967	149,000	412,000
1969	145,000	432,000
1971	335,000	439,000

---

[1] Figures in table were obtained from the Ministry of Education and Cultural Affairs.

TABLE II ENROLMENT IN GRADES IX - XII IN 1965 [2]

Grade	Science	Arts	Total
IX	94,593	24,748	119,341
X	143,054	31,828	174,882
XI	16,221	3,882	20,103
XII	21,517	4,733	26,250
IX-XII	275,385	65,191	340,576

With increasing numbers seeking secondary education, it became more and more apparent that, from the stand point of national and individual needs, the type of secondary education given prior to 1945 was inappropriate. The need for diversification became quite urgent; while, on the one hand, the type of secondary education had to be appropriate to the ability and requirements of each individual child, on the other, different types of secondary education related to national requirements had to be provided.

The following institutions are providing secondary education in 1967:

i. Madya Maha Vidyalayas (generally Grades VI to XII)

ii. Maha Vidyalayas (some all-age schools; some Grades VI to XII; some Grades IX to XII)

iii. Vidyalayas (Grades I to X)

iv. Private non-fee-levying schools (generally all age groups)

v. Private fee-levying schools (generally all age groups)

vi. Pirivenas (junior schools up to Grade X; senior up to Grade XII)

Generally speaking, schools in categories (i) to (v) are well provided with amenities for studies in arts, and science up to Grade XII. Almost all of them have work-shops and (in the case of girls schools) home-science laboratories and provision for teaching agriculture or commerce.

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[2] Figures in the table were obtained from the Ministry of Education and Cultural Affairs.

SCHOOL SYSTEM IN CEYLON

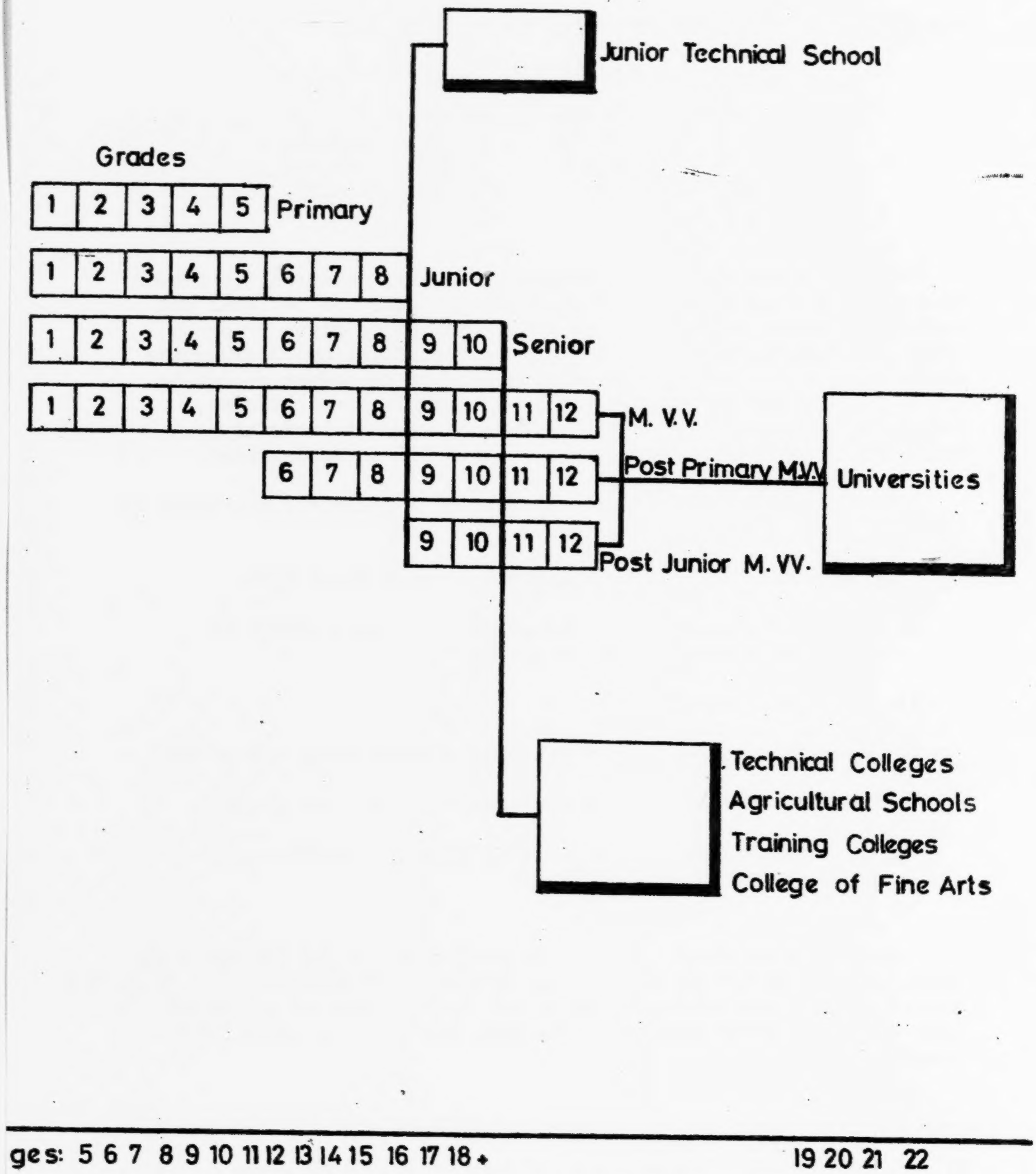
Junior Technical School
Grades
1 2 3 4 5 Primary
1 2 3 4 5 6 7 8 Junior
1 2 3 4 5 6 7 8 9 10 Senior
1 2 3 4 5 6 7 8 9 10 11 12 M. V. V.
6 7 8 9 10 11 12 Post Primary M.V.V.
9 10 11 12 Post Junior M. V.V.
Universities
Technical Colleges
Agricultural Schools
Training Colleges
College of Fine Arts
ges: 5 6 7 8 9 10 11 12 13 14 15 16 17 18 +
19 20 21 22

FIGURE 1

Government Maha Vidyalayas; some of the Grade II and almost all Grade III "assisted" schools, (now taken over to Government and named Maha Vidyalayas) and senior Pirivenas have courses up to Grade XII in arts and some have science, agriculture, home-science, commerce and crafts up to Grade X. The vidyalayas and junior Pirivenas have classes up to Grade X with a limited curriculum of arts subjects.

In the school system prevailing in Ceylon (Figure 1) it is often difficult to distinguish between a primary school and a secondary school, for development is by slow expansion starting with the lower grades. Thus the existing senior secondary schools (schools which have grades above Grade VIII), may sometimes have primary schools attached to them and often using the same building. The present position is shown in Table III.

TABLE III NUMBER OF SCHOOLS IN CEYLON [3/]

Grades	Category	Govt.	Non-Govt.	Total
I-II	Infants	148	3	151
I-V	Primary	1491	865	2356
I-VIII	Primary & Junior	2447	10	2457
I-X	Primary Jr. & Secondary	3239	22	3261
I-XII	Primary Jr. & Sec. Collegiate	712	34	746
VI-VIII	Junior only	13	-	13
VI-X	Junior & Senior secondary only	62	10	72
VI-XII	Junior, Secondary & Collegiate	231	13	244
IX-XII	Senior Collegiate only	18	7	25
		8361	964	9325

Plans for the establishment of uniform elementary education and diversified secondary education have been drawn up. Under the proposed schemes, as far as we are aware, general school education will be provided at 3 levels:

A. Primary: Grades I to VII (ages 5 to 11 years)

B. Lower secondary: Grades VIII to X (ages 12 to 15 years)

C. Upper secondary: Grades XI to XII (ages 16 to 18 years)

[3/] Figures in this table were obtained from the Ministry of Education and Cultural Affairs.

Diversification will commence at the end of Grade VIII (the end of the compulsory education period) and students may then study any of the following courses:-

i. Arts and law
ii. Physical sciences
iii. Biological sciences
iv. Commerce
v. Home-science
vi. Agriculture
vii. Fisheries

Categories (i) to (vi) are normally included in the courses offered by secondary general schools.

On the results of the G.C.E. Ordinary Level Examination, the pupils may later seek admission to Jestha Vidyalayas (Grades XI to XII) for Advanced Level courses in Arts and Science, Home-science or Commerce. Alternatively they may proceed to Junior Technical Schools (technical or agricultural) for craftsmen' technician's courses, or to senior technical schools for more advanced technicians' courses.

The majority of the schools mentioned in the foregoing description are secondary general schools and it is with these types of schools that this report is concerned.

1.03 The educational aspects of the study

The purpose of the educational part of this cost study was to identify the types of decision that affect the planning of each of the schools studied. In so doing, the following questions were asked:-

1. What is the gross covered area of space in the school and how is it divided into teaching spaces?
2. What is the enrolment in the school and how does this relate to attendance?
3. What is the curriculum of the school?
4. What planning process was followed in establishing the size of the school or of additions to it?
5. Are the buildings provided suitable, having regard to the number of children and teachers and to the curriculum?
6. Are the buildings provided suitable having regard to the methods of teaching employed in the school?

7. Is it possible, through better organisation of the curriculum and re-arrangement of teaching groups, to make better use of the buildings?
8. Is the problem posed in (7) above, such as to require a solution involving re-organisation of several adjacent schools to make the best use of the facilities they possess in common?
9. Is it possible to modify the present school buildings to make them more suitable, having regard to the requirements of curriculum and methodology?
10. Are new designs required, to provide accommodation for facilities for which at present no standard design exists?

1.04 Collection and analysis of material

Clearly only a small sample of schools could be studied in the available time but opportunity was taken to include buildings in the rural and urban areas of the Western Province, some schools at higher altitudes in the rural and urban areas of the Central and Uva Provinces and a school in the North.

The actual schools for which extensive data were collected are given below. A number of other schools were visited and useful background material obtained to supplement the main study:-

Western Province

School no. 1 - Homagama M.V.
no. 2 - Kudabuthgammuwa M.V.
no. 3 - Pannipitiya Dharmapala.
no. 4 - Mahawatta M.V. Borella.
no. 5 - Dehiwela Presbyterian Balika V.

Central Province

School no. 6 - K/Menikdiwela M.V.
no. 7 - K/Halloluwa M.V.
no. 8 - N/Hapugastalawa Muslim M.V.
no. 9 - K/Gamini M.V.

Uva Province

School no.10 - Bd/Walhaputenna M.V.

Northern Province

School no.11 - J/Madduvil M.V.

All of these schools have either been constructed or have had substantial additions made during the past 5 years. They thus represent the most recent developments in respect of design and, as the cost pattern for this period is known, provide useful samples on which to base the conclusions given elsewhere in this report.

At each of the schools visited, data was collected on standard forms, samples of which are given in Annexure I. As far as the educational aspects of the study are concerned, the data finally assembled included:-

i. Curriculum and special amenities of the school;

ii. Particulars of the staff;

iii. Site plan of the school;

iv. Attendance, grades and the number of classes;

v. Number and sizes of classrooms, laboratories, workshops and special rooms;

vi. Time-table of the school;

vii. Time-table showing utilization of teaching spaces;

viii. Particulars of the cost of the buildings.

From a study of this information it was possible to calculate the total overall space requirements of each school, having regard to the enrolment, teaching staff and curriculum and to compare the results of this calculation with the actual accommodation built.

It would unnecessarily lengthen this report to include the complete analysis for all of the eleven schools for which the data were collected, but an example showing the way in which the calculation is made is given in Annexure II together with an explanatory note.

The analysis of the sample schools disclosed a number of important aspects of school building utilisation and design, some of which have educational implications and other architectural design implications.

From the time-table it was possible to see the use-factor percentage[4] of each space.

It was observed that there was wastage of space for the following reasons:-

a) use of standard sized large rooms for small groups;

b) use of some teaching spaces for only part of the teaching day;

c) failure to use facilities of neighbouring schools when planning courses;

d) breaking up classes into small groups in order to provide an adequate number of periods of work for teachers to qualify for salary.

Because of the prevalence of a large number of elective subjects in the second-level school curriculum, children are inevitably divided for certain subjects into many groups, often small in number. The wastage incurred by the use of large uniform classrooms for small groups can be avoided by the provision of areas that can be screened into units of desired size or by provision of standard plans with classrooms of varying sizes. Capacity use of such teaching spaces can be planned by manipulation of the teaching time-table.

Further wastage can be attributed to the traditional organizational pattern of the secondary school. Pupils are normally taught in classes of 30 to 40 pupils. Units of this size form the basis of school organization. Because each class is regarded as an administrative unit, it requires a base room; hence, one classroom is allotted to each class, so that there are as many classrooms as there are units. The result is that whenever a class is at work in the laboratory or a special room, or in the playground, its classroom is unoccupied. Conversely when classrooms are all occupied, the laboratories, special rooms etc. are empty. Working on the basis that wastage can be avoided by the intensive use of rooms, it becomes possible to determine the number of each kind and size of teaching space required for a given number of pupils, following a given curriculum in a given school.

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[4] $$\text{Use Factor \%} = \frac{\text{Actual no. of hours room used}}{\text{Possible no. of hours room can be used}} \times 100$$

Heads of schools, it was observed, sometimes increase the number of subjects in the curriculum for the sake of quite small groups of children even when facilities in neighbouring schools for teaching the same subjects are not fully used. This practice is wasteful not only of classroom space but also of skilled teaching staff.

In some schools a larger number of small teaching groups than was necessary had been formed, with apparently no other object than to provide sufficient employment for excess teachers to achieve a qualifying number of teaching periods. One particular case appeared to have resulted in the construction of new accommodation to house the larger number of small classes that had been formed as a result of this practice.

It is difficult to tell from such a small sample whether or not such practices are widespread, but if so then they are placing a heavy burden on an already heavily loaded school construction budget.

There are, of course, several ways open to the Ministry, more positively to ensure that school principals do not obtain extra buildings to accommodate classes, resulting from what is, in effect, bad programming. Of these the safest is the "area check". It can be shown that in the design of schools for Ceylon the areas per place given below are adequate for all classroom, laboratory, home-science and special rooms, offices, toilets and circulation space.

Primary schools	14 sq.ft. per place.
Secondary schools	32 sq.ft. per place.

If a principal makes a request for extra accommodation all that is necessary to determine whether or not it should be provided is to divide the gross covered area of his existing accommodation (classrooms, corridors, toilets, offices, labs etc.) by the average attendance and to compare the answer with the optimum area per place given above. If the area is less than the optimum, the principal needs more accommodation; if it is more, then he already has too much accommodation and should re-programme his time-table to make better use of what he has.

Another difficulty connected with this problem is to decide, when new construction is approved, just what is to be provided by way of new building. It was observed that additions most frequently take the form of classroom blocks or open halls. The special rooms so much needed for the proper education of children in upper secondary schools have not been provided, even though it would have been possible to keep below the ceiling cost if special rooms and the classrooms both had been suitably constructed and intensively used.

05 Educational planning and training

It is clear that if the best use is to be obtained from the money allocated for the construction of new school buildings, then certain criteria should be established to determine the types of building needed and the validity of the need in relation to the existing accommodation.

These criteria, however, should not relate merely to the situation at the precise time that the request for construction is made: as has already been shown in Table I, secondary school populations are increasing and, moreover, the numbers electing to specialise in sciences, arts and other fields will vary from time-to-time. There should thus be an element of forward planning built into any proposal for new buildings. When any additional accommodation is to be provided, the following questions may be asked:

What is the rate of change of population in the zone or catchment area from which a school draws its pupils?

What is the estimated output of primary feeder schools in the forseeable future?

Do the numbers specialising in arts, sciences, commerce and the like show any marked tendency to increase or decrease?

What are the trends?

In a country such as Ceylon, where new schools are built or existing buildings extended as a result of 'local' requests for improvements, rather than as a result of centralised and detailed direction of the building programme by the Education Ministry, then every school principal becomes, as it were, the educational planner for the small area from which his pupils are drawn.

Simple micro-planning at this level is, it is true, far easier than educational planning at district or national level but nevertheless it requires the use of skill and exercise of judgement. It would be both useful and profitable if the Ministry were to circulate a small pamphlet to principals of schools, explaining the criteria for extending an existing school and giving examples of the calculations (See Annexure II) needed to establish the nature and size of any new accommodation that might in future be required. Short, one-day seminars on this topic conducted at regional level, would usefully supplement the printed material and enable principals to discuss and clarify points of difficulty.

In this connection, Ceylon now has a number of officers in the Ministry, who have attended the annual courses held at the Asian Regional Institute for Educational Planners and Administrators at New Delhi. Seminars conducted by these officers could greatly improve the quality of requests of new buildings and ensure that money was spent where it was most needed.

From 1967 the Asian Institute is adjusting its annual course content to allow participants to specialise in several detailed aspects of educational planning. One of the elective subjects offered will be in planning as it affects building. It would be useful when the Ministry nexts assigns an officer to attend the course if he were instructed to elect to specialise in the building section. On return, this officer could then be delegated authority to deal with the educational planning and administration matters raised in this chapter.

CHAPTER - 2

FACTORS AFFECTING THE COSTS OF SCHOOL BUILDINGS IN CEYLON

2.01 General

It has been shown in Chapter 1 that administrative procedures and curriculum implementation both affect the call on the capital works budget for new schools; but in the Ministry of Education itself and in the Regional Offices there are other factors that have a bearing on the amount of money spent on approved building projects. The design of standard plans, tendering and contracting procedures, inspection procedures and maintenance of buildings already constructed can all affect capital expenditure. In the Ceylon Ministry of Education, matters such as these are regulated for buildings of a value up to Rs.200,000 (shortly to be increased to Rs.500,000) by a single unit known as the School Works Branch. The capacity of the Branch properly to administer these matters needs careful consideration.

2.02 The School Works Branch of the Ministry of Education

The School Works Branch consists of the Superintending Works Engineer, 4 School Works Engineers, 244 Technicians and 34 clerks and typists. An organisational chart is attached in Annexure III.

In a dramatic comparison with the P.W.D. and the State Engineering Corporation, Table IV shows how seriously understaffed the Branch is at the professional level.

TABLE - IV ANNUAL VALUE OF WORK IN MILLION RUPEES [5]

Year	P. W. D.	S. W. B.	STATE ENG.CORP.
1962 - 63	76.37	12.91	.68
1963 - 64	82.43	26.25	8.85
1964 - 65	80.47	36.57	24.09
Max. possible value of work with present establishment of staff given below:-	100.00	30.00	30.00
Technologist[6]	215	7	45
Technicians	1246	211	92
Craftsmen and others	3274	-	693

In the year 1966/67 the School Works Branch was allocated a budget expenditure of Rs.29,777,000 for capital works of which it is estimated 60% will be committed by the end of the financial year. This expenditure involves the preparation of contract documents and the administration and supervision of some 1500 separate building contracts.

In addition to the capital works expenditure the S.W.B. was allocated Rs.4 million for maintenance.

The estimates of expenditure for 1967/68 provide for a sharp increase in the amount to be spent on educational building. Some Rs.41 million with an additional Rs.6 million for vocational schools is to be committed in the year 1968/69. If the buildings to be constructed were simple elementary schools the problem of handling a sum of this magnitude with such a small staff would be almost insuperable. In fact, due to the increase in the value of contracts handled by the S.W.B. to a Rs.500,000 maximum, the buildings that will now become the responsibility of the Branch will include junior universities, vocational schools and secondary schools, buildings in fact, for which the current standard plans are quite unsuitable.

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[5] Extract from Report of the Committee on Construction Capacity. Colombo, Public Works Department, June 1966.

[6] Technologists = School Works Engineers, architects and other professional officers.

Undoubtedly this volume of work will place an impossible strain on the organisation and personnel of the School Works Branch and it would seem important in the first instance if the building programme is to be realised at all, to fill the established posts and bring the branch up to its full strength. The Estimates for 1966/67 include the following technologists, the number in brackets indicates the posts actually filled:

	Head Office		Regions	
Superintending Engineer	1	(1)		
Engineer	1	(1)	4	(3)
Assistant Architect	1	(0)		
Total:	3	(2)	4	(3)

Three aspects of this unsatisfactory staffing situation result in waste of capital expenditure:-

i. Very little can be done to revise the standard plans for school building used by the department and to produce the new plans needed for junior universities and vocational schools;

ii. Inadequate supervision of building works in progress leads to the acceptance of sub-standard work which ultimately becomes a charge on the maintenance budget.

iii. There is no regular, systematic maintenance inspection of the present stock of schools by the S.W.B. and it is thus necessary to rely on Principals or Circuit Inspectors for reports on these matters. This not only leads to delays in carrying out repairs but worse, also means that many defects are either never reported at all or, when reported, the buildings are beyond repair.

It is estimated that the total cost of the School Works Branch is between 1.2 and 1.5% of the value of the work it undertakes. This may be compared with similar situations and departments elsewhere:

Delhi State	12.75%
Rhodesia	14.15%
W.Australia	8-10%
Private architectural firms (Ceylon)	8%

The low cost of running the S.W.B. should not be taken as an indication that it is an economical Branch, but rather that it is lacking in normal professional and technical staff commensurate with the annual value of work it carries out.

Substantial savings can be made on the costs of the existing standard plan (preliminary investigation indicates that this saving will be over 10 per cent, that is, over Rs.2 million in 1966/67) if the Branch had the time and staff for this development work. The possible saving in costs would appear to more than justify the immediate recruitment of staff to complete the establishment.

The main savings that might be expected in future will arise from refinements of architectural design coupled with careful costing of alternative solutions. Some suggestions for reductions in costs resulting from such studies are included in the paper. However the Ministry is not solely concerned with small buildings for which standard plans can be developed: there is, as education in Ceylon develops, an increasing need for larger and more specialised buildings. In 1967 alone, the design of the new Junior Universities, the Junior Technical Schools, the College of Advanced Technology and the College of Fine Arts and Design have had to be undertaken and, if the School Works Branch had been more adequately staffed, the many problems arising from these projects might have been resolved more easily.

In view of the urgent need for technologists in the School Works Branch two suggestions are made:

i. That the establishment of the S.W.B. be increased as follows:

Post	Head Office	Regions
Head of School Works Branch	1	
Architect	1	
Assistant Architect	1	
Structural/Civil Engineer	1	
Civil Engineer (Costs & contracts)	1	
Civil Engineers		14
Totals:	5	14

This increase will raise the annual budget by about Rs.20,000 and in the 1966/67 budget would have resulted in savings of over Rs.2 million.

The reason for the large increase of 10 engineers in the field is to ensure that contracts are correctly carried out and to control and raise the standard of maintenance.

ii. In view of the difficulties of recruiting an architect and a cost expert in Ceylon it is suggested that two, intermediate level architects from the Faculty of Architecture, Colombo University, and one building technologist be selected for training overseas and that in the interim period technical assistance be sought from Unesco or some other agency for the provision of an architect and a quantity surveyor for a period of 36 man months.

In the field the financial control of school building depends upon thorough supervision by those in charge.

The Regional and District offices should be provided with basic survey and drawing office equipment, which will allow site plans to be more accurately prepared and schemes for alterations to be drawn up.

As the importation of private vehicles is severely restricted, a government vehicle should be provided at each Regional and District office to enable the officers to move about the areas with greater freedom. There is the suggestion that officers are somewhat loath to use their own cars because of the difficulty of obtaining replacements. If this is the case, then the result is that supervision of contracts will be cut to a minimum whereas there is the obvious need for maximum control of building activities. Vehicles and equipment could also be included in requests for assistance from international agencies (U.N.,Colombo Plan etc.)

2.03 Standard Plans and Building Construction

The use of standard plans pre-supposes that they are an ideal solution pedagogically and economically, to the school building programme and that the buildings are suitable for all climatic conditions on the Island.

Innovations have been introduced recently to bring down the building cost, but there are still many aspects of constructional design that should be investigated with a view to finding different and cheaper methods of building.

Some of these items are:-

1. Footings

Except for the more recent drawings for the standard single-storey classroom block, the footings are not in keeping with present day practice. The depth of excavation and spread of the footing is generally excessive and where the nature of the ground is such that these conditions necessitate this type of foundation, consideration should be given to the use of cheaper "pile and beam" foundations.

2. Roof framing

A new form of roof truss and roof framing should be developed. The present design requires long and heavy sections of timber both of which are becoming increasingly difficult to obtain. It should be possible in conjuction with the Forest Department, to produce a roof framing that will reduce the timber content up to 50% and require much smaller sections.

In this connection reference should be made to the work of the Timber Development Association of London, who publish details of over 23 light-weight timber roof trusses, many of which are suitable for schools. Design for light-weight trusses have also been produced inter alia, in Australia, India, Malaysia, Indonesia, Canada and Ghana. [7]

There is thus no difficulty in obtaining savings from the redesign of roofs.

3. A more general use of reinforced concrete-framed buildings should be made for two-storey buildings and above.

4. More use should be made of the better quality wire-cut bricks that are available, as these will allow thinner load bearing walls to be used and all walls to be finished "fair-faced" thus dispensing with the need to plaster.

5. For two-storey buildings, room heights should be reduced to 8'6" for ground floors, measured to the underside of the beam, and 9'0" to soffites of ceilings on second floors.

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[7] Reference to many of the details mentioned may be made in the ARISBR library, and to its Accession Lists.

6. The present specification for frames to the door and windows require very heavy sections and new frame sizes should be developed in conjunction with the Forest Department.

Another uneconomical factor resulting from standard plans is the use of different standard units of accommodation, a three- or a five-classroom unit. It would appear to be normal practice to add to a school without regard to its overall size or the proper utilisation of the site. Consideration should be given whenever possible, to extending existing buildings instead of constructing new, separate units, thus effecting small savings by utilising portions of the existing structure. This will allow a more economical use of land in the areas where games spaces or gardens are needed.

Figure 2, shows a school in which if a new unit is to be built, either the volley-ball court will have to be used or additional land acquired. By filling in the spaces as indicated these alternatives are avoided.

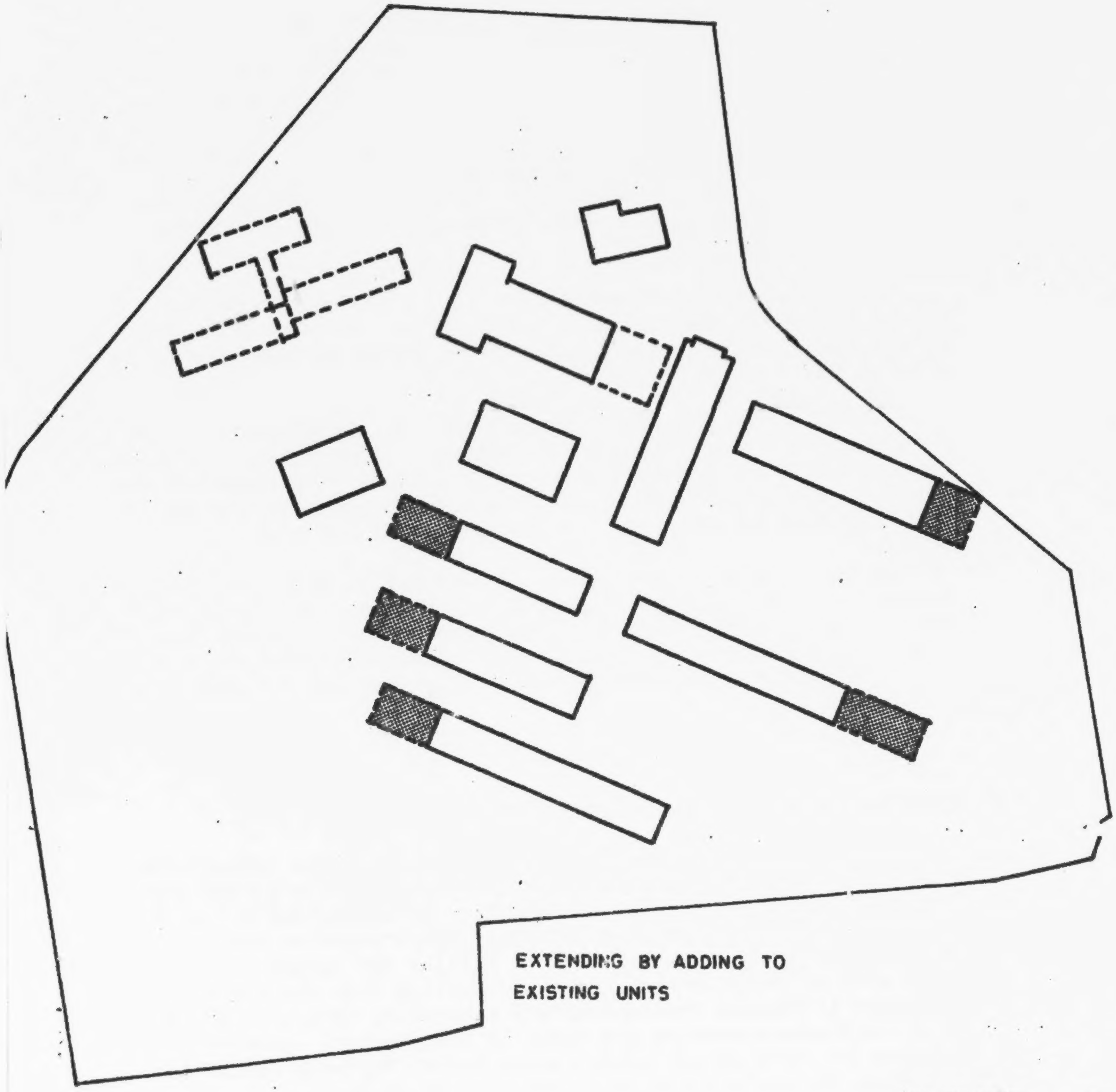
It would appear that the administrative convenience of using a standard unit on all occasions - often it seems purely for prestige reasons - without considering the ultimate development of the school or the possibility of altering and adapting existing buildings, can lead to additional expenditure being incurred.

As has already been suggested in Chapter 1, when considering requests for new units of accommodation, a simple test based on the minimum space required per pupil/place should be made. Any school, which already has an amount of space sufficient for its enrolment should be required to justify its request for additional accommodation.

2.04 Tendering Procedure and Contractual Methods

Normal procedures of advertising and calling for competitive bids are followed, except that works costing up to Rs.25,000 can be and often are, offered to Co-operative Societies and P.T.A.'s approved by the Ministry at a contract figure based on the Department's estimated cost, without calling for competitive bids. There seem to be no abnormal delays resulting from the standard procedure of calling for tenders and submitting them for approval as all officers concerned are aware of the urgency. However an increase of staff at the School Works Branch may well reduce to a minimum any administrative delays that do occur.

CEYLON SECONDARY GENERAL SCHOOLS. EXTENSIONS TO SCHOOLS FOR BETTER SITE USE & REDUCED COST



EXTENDING BY ADDING TO
EXISTING UNITS

FIGURE 2

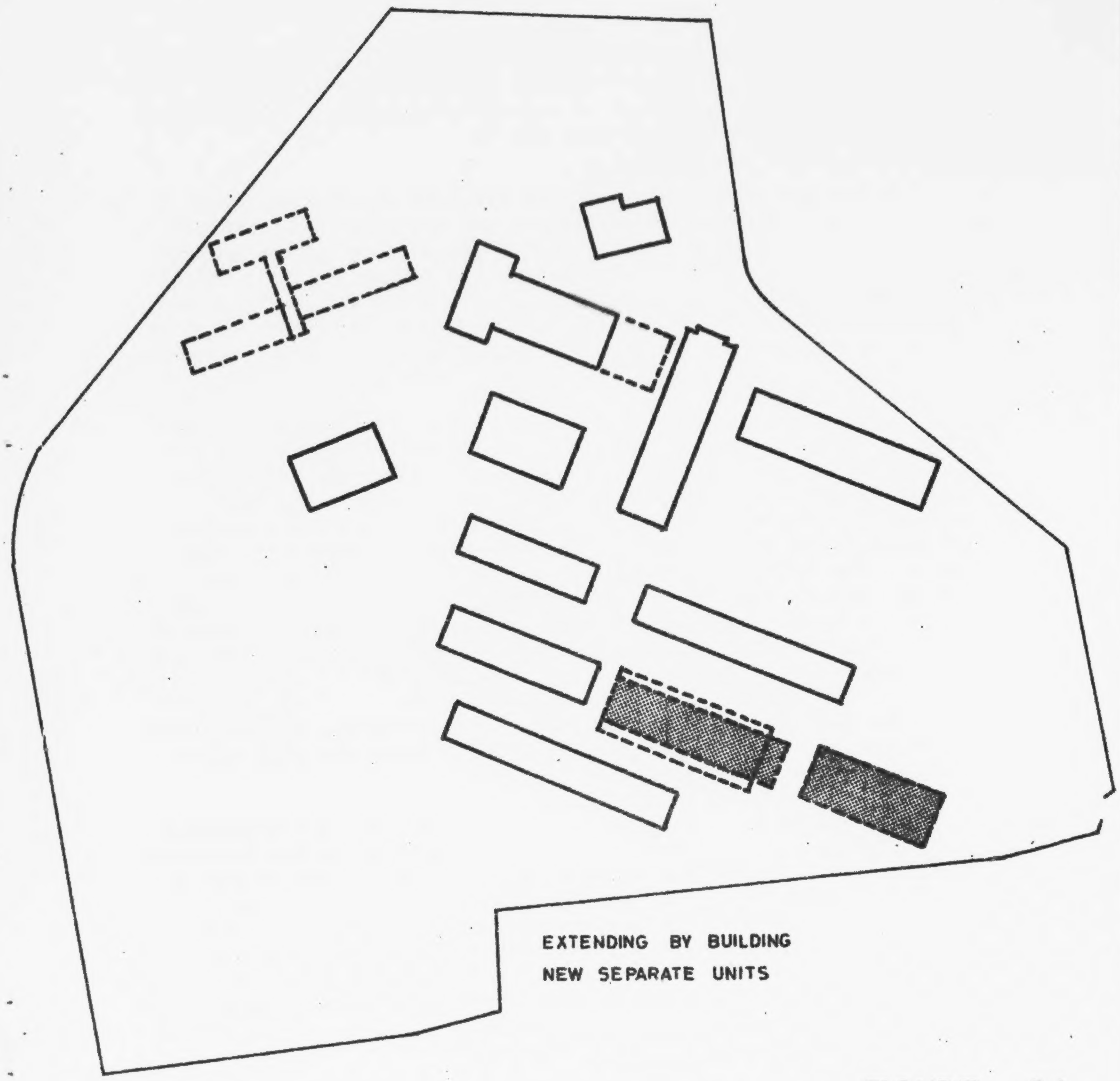

EXTENDING BY BUILDING
NEW SEPARATE UNITS

FIGURE 2A

While the field-work for this study was in progress, general comments were made to the effect that many of the building contractors are unreliable, do not complete the work within the contract time, or produce sub-standard work. It would seem that these comments are passed about all builders in all countries and although sometimes they may be true, it is doubtful if they apply in every case.

A careful selection of building contractors based on past performance and known organisational abilities and financial backing and the introduction of selective tendering will eliminate the inexperienced or undesirable builder.

Experience overseas shows that the more capable building contractors with large organisations are not usually interested in tendering for comparatively small jobs as they cannot compete with the smaller builder. To attract the larger and more capable contractor, a form of contracting can be introduced, which offers a number of small value contracts in a series, the total value of which is sufficiently high to interest larger and better organised builders.

Under this system the number of similar units of accommodation to be built within that year (say, within a particular District) is made known and selected contractors are invited to submit bids for a typical unit. The builder submitting the lowest bid is given the opportunity of negotiating for a series of units based on his original rates with a guaranteed mimimum value. The rates in his original bid will form the basis for future jobs, irrespective of location, variation in sites or of larger or smaller volume of work. Of course this must be subject to the Department's being satisfied with the arrangements and the performance of the contract at all times.

The actual cost of each unit may vary according to the amount of site work required, but the schedule of rates for such site-work will remain constant.

The advantages of serial contracting as the above-mentioned procedure is called, apart from time-saving in preparing documents for tendering is that the builder is encouraged by the incentive of a large volume of work spread over a period, and pricing is generally keener as he is better able to organise his men and material. Furthermore, where new systems of construction are introduced, the builder is less likely to load his prices as he will become familiar with the new techniques as he progresses through the series.

5 Schedule of Rates

The schedules of rates prepared and used by the School Works Branch by and large is fair and provides for good quality work to be carried out. The rates are slightly higher than those likely to be obtained from building contractors in competition under normal conditions, but nevertheless they form a sound basis for departmental estimating.

The shortage of some materials, particularly timber, is tending to increase the rates and some form of control such as the issue of licences may be required in order to stabilise costs. Also the shortage of materials can influence future maintenance costs in that there is the temptation to use substitute materials of a lower standard and specification as in the case of aluminium sheeting where mild steel fastenings are used, leading to early corrosion of the aluminium. As a general increase in costs is almost inevitable, due to the rise in prices of materials and the increase in labour charges, it is suggested that a fixed limit of cost be imposed on the various units of accommodation, i.e. classroom blocks etc. The limit could be based on the 1964 average cost.

This measure would require that any future increase in building rates, would have to be offset by savings achieved through more economical design. It is only when it is impossible to make any further savings that an increase in the cost of the unit should be sanctioned. There is thus a constant need to revise standard plans and as has been mentioned above, the School Works Branch will need a larger staff to undertake this continuing task.

As it is almost impossible to fix rates which are applicable in all parts of the Island, due to (say) variations of cartage costs in hauling materials to the various sites, it is suggested that the District offices concerned be given authority to adjust rates where necessary or be given approved rates for use only in their particular district.

The use of general average rates, although administratively convenient, can give an unfair advantage to some localities and cause delays in others, through negotiations with contractors to persuade them to accept the Departmental rates. In some cases this may lead to fresh tenders being called if the negotiations fail.

2.06 Bills of Quantities

Generally the bills of quantities prepared by the School Works Branch are commendably brief and adequate for the standard type of building in use. However, where the contractor is asked to price items which contain descriptions of alternative materials or construction, these should be given as separate alternative items one of which can be priced and the other struck out. This will avoid possible disputes as to what was intended by the contractor at the time of tendering and what is actually supplied.

A spot check has been made on some of the measured quantities in the bills which indicate that there is a consistent overmeasurement of upwards of 10% which represents a "hidden contingency fund." Fortunately the work is re-measured on the site and the contractor is paid only for work actually done, so that, in normal circumstances, it is unlikely that the contractor gains the benefit of the overmeasurement. Nevertheless, this overmeasurement means that funds are unnecessarily tied up until the accounts are finally settled.

It must also be remembered that the Departmental estimates carry a 10% loading for contingencies, and this in effect means that some projects have a double contingent fund. The more recent bills of quantities do not contain this overmeasurement and it is recommended that high priority be given to work on remeasuring all standard bills.

2.07 Maintenance

Table I above shews clearly that the rate of increase of enrolment in Ceylon's schools has rapidly decreased in recent years. This is as it should be, for by now the majority of the children eligible for education are receiving it and future increases in the school population will occur only due to increases in the birth-rate and, to the slow drawing into the educational system of those of compulsory school age who are not attending school.

This situation will become increasingly reflected in the school building field. Fewer new buildings will be built and more and more attention will focus on the (perhaps less exciting, but none the less important) task of maintaining the Nation's stock of schools in a state of good repair.

The budget for maintenance of schools should thus increase quite sharply every year for as the buildings age, they will require progressively more attention. It is surprising to note in this context, that the 1966/67 Budget vote for Maintenance is 20% less than the vote for the previous year and this against an increase in expenditure under the General Recurrent vote Head 4.

Yet every school visited during the course of this study required maintenance and in one or two cases, the state of repair was such as to make it obvious that substantial rebuilding would be needed in the near future.

No clear pattern of maintenance expenditure per school calculated on a per pupil place basis has emerged from the cost study. Indeed details of expenditure on some of the schools were not readily available. It would also appear that the general standard of maintenance of the school building is relative to the drive and initiative of the principal and/or the PTA or other similar organisations.

So far as it can be established no triennial or quinquenniel maintenance inspection of school buildings is made by the School Works Branch and much of the information of the general state of repair is received through reports or requests by the principals or the circuit inspectors.

It is considered essential, if there is to be a concerted effort to maintain the buildings, that an inventory of the schools first be made to show the condition of the buildings as well as the number of teaching stations, classrooms, staff-room, toilets etc. This latter information will be of great help when replacement or improvements are considered. It would be necessary for the School Works Branch to make a survey of 20% of the schools each year, which is equivalent to a quinquenniel inspection.

Guide lines and schedules of priorities such as "emergency", "essential", "desirable" can be drawn up to assist the inspecting officers in classifying the work. On-the-spot estimates can be made against each classification and in this way fairly reliable annual estimates of maintenance expenditure can be established and, in the light of funds available decisions made as to the classification of priorities in which work can be undertaken.

On completion of the initial survey, it should be possible to produce for maintenance, improvements and replacements to the whole stock of buildings, life-tables which will allow programmes to be developed in the various categories of "emergency", "essential", "desirable".

Grouping of maintenance items, which in turn can be put into a priority category could be as follows:-

1. Major repairs caused by the age of the building and necessitating substantial renewal of the building

2. Major repairs caused by prolonged deterioration and neglect, but where the fabric of the building has otherwise anticipation of long life.
3. General repairs, such as renewal of damaged roofing, leaking gutters, broken sashes, doors etc.
4. Colour washing and minor repair to cracks in plaster, reglazing, re-fixing hinges etc.

Opportunity is often taken in conjunction with maintenance items to extend the existing building. Careful consideration must be given to these cases, not only from the economic viewpoint of whether to replace or repair the buildings, but also from the standpoint of whether the school serves the entire population or not, and whether the buildings are pedagogically suitable or not. Further, in all instances when a decision is made on whether or not to repair or replace a building, its expected life after repair must be considered.

It is understood that colour washing has a very low priority. This is a pity as some of the schools visited had an air of terrible dilapidation which could have been relieved by merely the cost of paint or colour wash. Further regular painting with light, reflective colours internally of classrooms and externally of corrugated asbestous roofs will add to the comfort of the pupils, the first by raising the level of illumination and the second by reducing the amount of heat passing through the roof.

It is also possible that regular painting would reveal accumulated neglect caused through leaking flashing, rainwater pipes, etc., and damage to the fabric by planth growth as these repairs would be dealt with at the time of repainting.

A suggestion might be to offer a grant for such painting, the Ministry contributing one rupee for every rupee collected from the community and thus to make it possible for painting contractors to be employed.

As far as new buildings are concerned, the specification, selection of materials to be used, and the design and detailing all influence maintenance costs and should be kept under constant review. Those items which require constant maintenance should be investigated and the specification or detail revised. For example, in many schools visited the floor paving had broken up: this may be due, among other things, to the inclusion of sand in the screed. It is possible that a granolithic topping consisting of fine granite or "metal" chippings and cement, without sand, would provide a harder and longer lasting surface. The substitution of brick paving with a concrete slab properly laid with light reinforcement will also assist in prolonging the life of the floor. The initial cost may be higher, but the savings in maintenance will offset this.

Another example is the internal plastering, the specification for which should be re-examined, and a harder wearing surface provided. In one school visited almost 60% of the internal plastering had to be re-done within two years of the school's being taken over and at almost 100% of the initial cost.

Again the use of the face brickwork and quality wirecut brick, although having a higher initial cost, will save the cost of plastering and of all future maintenance.

If reglazing windows presents a problem because of high cost of material and the difficulty in obtaining glass, then consideration should be given to the use of asbestos cement or plywood panels, which can be painted white to reflect the light. These panels can be easily and effectively used as louvre blades and it should be possible to develop a new type of window sash which would allow the use of this type of panel to act both as a shutter and a sun-screen.

Defective work during the construction stage will also lead to higher maintenance costs and it is essential therefore that all construction work be closely and competently supervised.

2.08 Costs of new units of accommodation

Chapter 3 of this Report suggests ways in which it is possible greatly to economise in the cost of new units of accommodation through tigher planning and the exclusion of wasteful elements in the standard plans. Adjusted standard plans have been prepared in the Institute and the estimated costs of these new units of accommodation have been based on the Department's Schedule of Rates for similar work and a pro-rata rate taken for work not of a similar nature.

The schedule on the following page gives a comparison of costs between the existing standard units and the adjusted units.

TABLE V COMPARATIVE COSTS OF EXISTING AND ADJUSTED STANDARD UNITS

Type of Unit	Old Cost Rs.	New Cost Rs.	Percentage saving
Science Laboratory (single unit)	22,000	15,500	29.5
Workshop Unit	23,000	19,450	15.2
Home Science (large unit 60 girls)		29,466	
Home Science (small unit 20 girls)	24,000	9,000	52.5
Library and Reading Room	13,000	11,000	15.2
Classroom: single storey (block of 10 bays, office and store)	19,000	16,400	13.7
Classroom: 2-storey (block of 8 rooms)	85,000	68,000 (Alternative A)	20.0
Classroom: 2-storey (block of 8 rooms)	85,000	64,093 (Alternative B)	25.0
New Standard Staff Unit		11,100	
New Standard Toilet Unit		6,530	
New Multi-purpose unit (A)		45,480	
New Multi-purpose unit (B)		45;480	

The costs and savings are indicative of what can be done. Undoubtedly when working drawings are prepared and detailed quantities are taken off and priced there will be differences in cost, but these differences should not be great. Also it may not be possible to introduce all of the changes of construction at one time. Nevertheless if reduction in cost of the units is to be achieved in face of rising building costs then some form of development work must be undertaken and it is suggested that prototypes be first erected, the construction of which should be closely supervised. The specification and detailing can be checked and revised where it is found to be impracticable or unsuitable.

Even if there are no changes of construction made, there will be savings if the new reduced areas are adopted.

19 Trends in costs

There are two main factors influencing future costs:-

(i) the inevitable rise in costs of materials and labour;
(ii) the additional facilities required by an expanding curriculum.

Present indications are that building costs are rising each year. Up to a point this can be offset by continued development of new forms of construction such as prefabricated components, better site organisation and more efficient use of labour; by the reduction in the amount of materials used; and by increased production of materials.

If rising costs are to be contained in this manner then there must be close and continued collaboration between the Department, the building industry and the manufacturers. The work already undertaken by the State Engineering Corporation in the development of prefabricated units should be extended and further developed to a stage where approved associations and building contractors are able to purchase the components as stock items. Similarly, the Forests Department and the Small Industries Corporation could develop a light-weight roof truss and other joinery items which again could be bought as stock items.

Selected building contractors might also be invited to participate in development work, such as improvement in the quality of the concrete work, so that advantage can be taken of higher stress gradings for the design of reinforced concrete, with its consequent reduction of the quantities of material used.

All this development work would need to be co-ordinated and a long-term building programme established. It is recommended that the Development Group already formed in the Department be given the required professional and drafting staff and its terms of reference widened to consider aspects of the design of all types of schools.

There is also a tendency for costs of the secondary school to rise steeply with the addition of special units of accommodation. The addition of a single standard laboratory unit to a school with an enrolment of 400 for example, will raise the cost of the school by Rs.52/- per pupil place. Moreover, there is as stated in Chapter 3, a need to improve the amenities for staff and students. This too will cause a rise in the cost per pupil place in the immediate future and must be offset by more careful use of space, greater utilization of existing buildings, and careful educational planning in the provision of additional space and teaching units.

Although it will be difficult, due to the varying ages of the buildings, to apply the concept of maximum cost per pupil place as a yard-stick for future development of any school, it should not be difficult to apply the concept of minimum space per pupil place. As previously mentioned in Chapter 1, a simple test to put to any school requiring additional accommodation would be: "Has it more or less space than the minimum requirements?" If the existing space is greater than the minimum allowed, then the school must seek to justify the extension.

2.10 Variations in per place costs

In concluding this chapter, attention is once again drawn to the evidence found, of the irrational allocation of buildings to various schools, and to the waste that inevitably occurs.

It is well established that as the size of a school increases so the area, and thus the cost per place, should reduce. A simple example will serve to illustrate this fact in connection with a secondary school as seen overleaf in Table VI.

There is a very clear reduction in area per place as the size of the school increases.

TABLE VI COST PER PLACE IN RELATION TO SIZE OF SCHOOL

New School	240 places	480 places	720 places
Headmaster's room, office, staff room	600 ft^2	no increase	1000 ft^2
Toilets	200 ft^2	add 150 ft^2	add 100 ft^2
Laboratory	424 ft^2	no increase	add 424 ft^2
Workshop	1365 ft^2	no increase	no increase
Home Science	1040 ft^2	no increase	no increase
Library	700 ft^2	no increase	no increase
Classrooms	2800 ft^2	add 2800 ft^2	add 2800 ft^2
Total	7129 ft^2	10079 ft^2	14403 ft^2
Area per place	29.5 ft^2	21.0 ft^2	20.0 ft^2

Further evidence on this point may be cited. In a recent preparatory study of Junior Technical Schools for Ceylon it was found that:-

for a school of 120 places the cost per place was Rs. 2500

for a school of 270 places the cost per place was Rs. 1500

for a school of 520 places the cost per place was Rs. 1300

The law is one of diminishing returns as is shown in Figure 3. But studies of the schools visited in the various regions of Ceylon show that the area per place in relation to enrolment does not show a saving as the number of pupil places grows. Figure 3 illustrates this dramatically. Schools numbers 11 and 4 in the figure have far more space than they need. Figure 4 shows this data translated in terms of costs. Schools, 10, 11 and 4 have obviously been not controlled in their building work in the same way as School 1, which approaches reasonable economy in its total costs.

RELATIONSHIP BETWEEN SIZE OF SCHOOL AND TOTAL NETT AREA PER PUPIL/PLACE BASED ON AVERAGE ENROLMENT

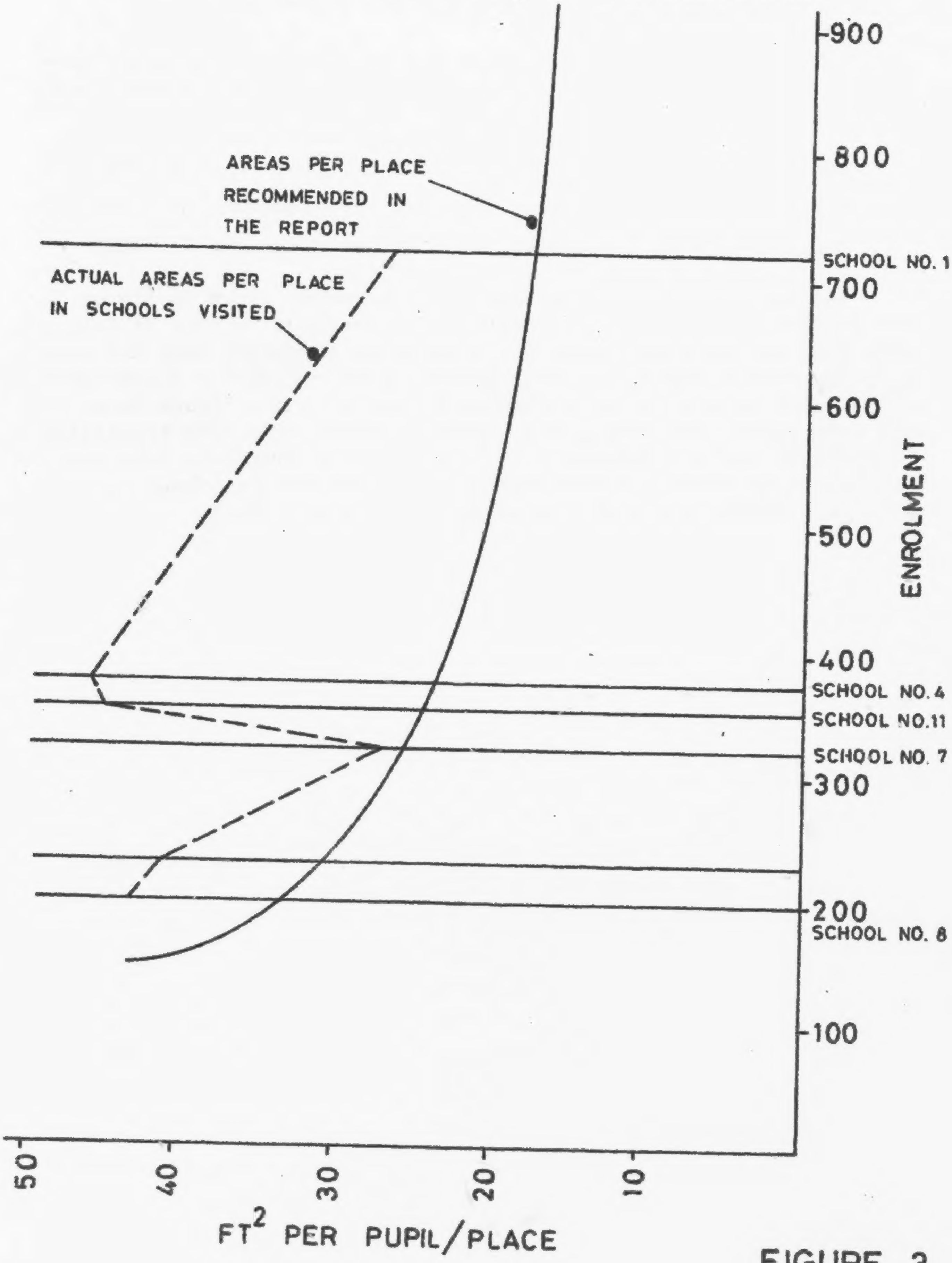


FIGURE 3

CHART 1

RELATIONSHIP BETWEEN SIZE OF SCHOOL AND COST PER PUPIL PLACE BASED ON AVERAGE ENROLMENT

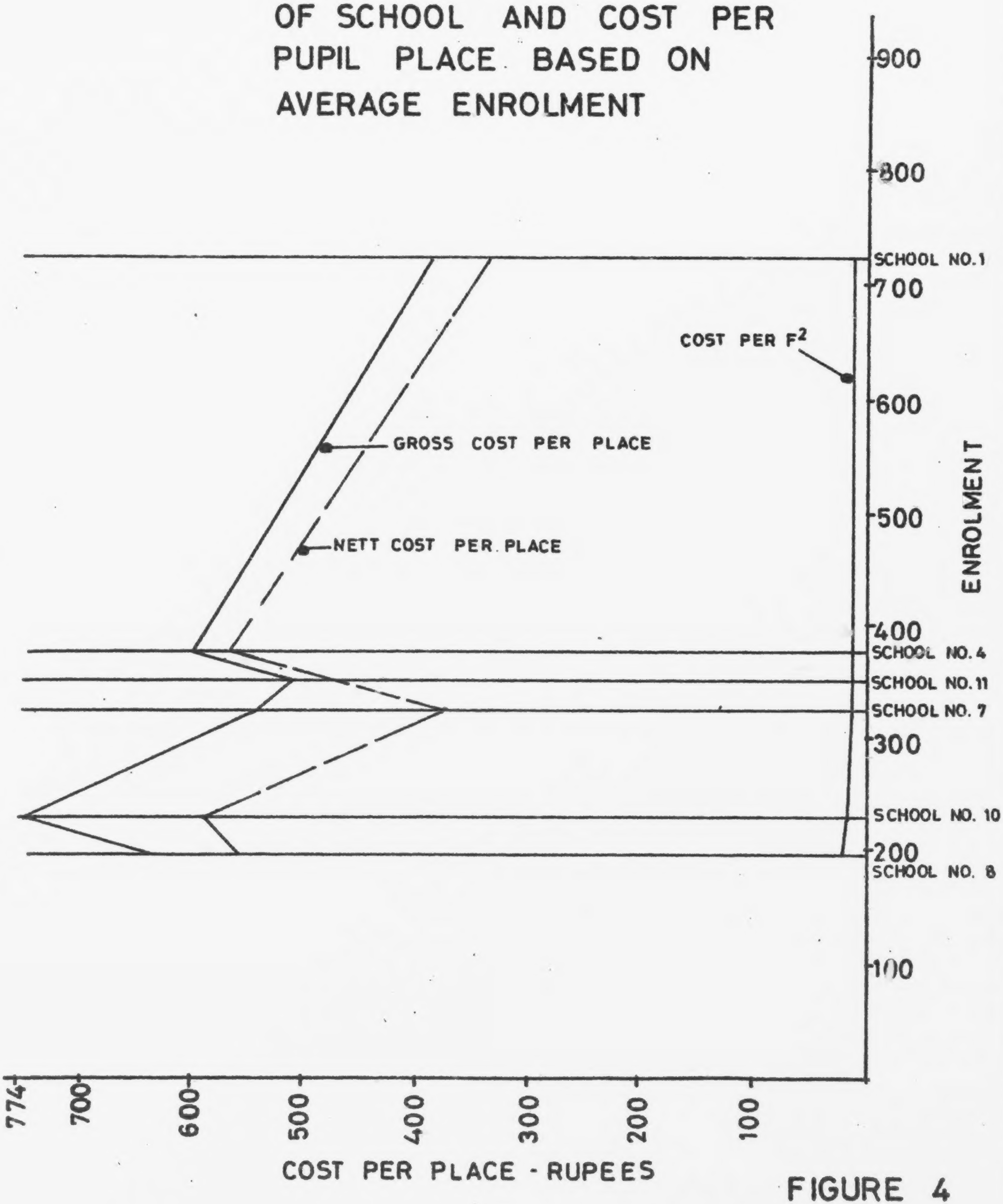


FIGURE 4

CHAPTER 3

STANDARD PLANS

3.01 General

Ceylon is more fortunate in the number and quality of its school buildings than many of Unesco's other Asian Member States. Some 90% of the children of primary school age are receiving education in buildings the majority of which are constructed of bricks, timber and concrete with clay-tiled or asbestos roofs. Much of the new building that is at present needed is thus in connection with the expanding programme of secondary education - new classrooms, science laboratories, workshops, home economics rooms and the like.

Even at secondary level there is a substantial stock of classroom accommodation and it is clear that future building will, in the main, take the form of additions to existing schools. What is important then, is to check on the suitability of present standard plans for this purpose and, if necessary, to adjust them in such a way as to make them cheaper and more easy to adapt for future needs. At the same time, it is important wherever possible, to improve amenity through consideration of the requirements of students and teachers and of the educational programme. There must, moreover, be improved standards of staff accommodation, better provision of toilet facilities, and higher standards of thermal comfort and illumination. Standards must be raised and the present position consolidated.

These aims are not, as is shown below, incompatible with a general reduction of costs. They can be achieved through careful design, through planning and through greater exploitation of the properties of local building materials already commonly in use. This involves:-

i) Tailoring the needs of the school to the requirements of the curriculum and the anticipated enrolment: this will ensure that only the minimum number of teaching stations are provided.

ii) Reducing, where possible, the area per pupil place in the various teaching stations.

iii) Skilfully planning the arrangements of the teaching spaces to limit the amount of circulation area.

iv) The use of up-to-date building techniques and constructional developments. (The constructional design of some of the units has remained unchanged since the turn of the century.)

v) Sensible selection of materials and the avoidance of high cost materials or "features" which add nothing to the quality or efficiency of the buildings.

From the above it will be seen that there must be close collaboration between the educational planner, the architect, and the quantity surveyor, if real reductions in cost and improvements in design are to be achieved.

A study of present standard plans and of school buildings in several of the fourteen regions suggests two main avenues of approach to the problem of improving amenity and reduced per place cost.

They are:-

i) Re-design of the main buildings for which standard plans are at present available.

ii) The design of a new multi-purpose unit to overcome the educational difficulties and high costs inherent in the construction of separate, isolated units when adding to an existing school.

Although this report contains suggestions for amendments to standard plans, it is recommended most strongly, that when trained architects and quantity surveyors become available, the Ministry form a permanent Development Group comprising an educationist, architect, quantity surveyor and a supporting staff with a view to creating opportunities for a continuing dialogue between educationists and designers, the results of which will take the form of new prototype schools to meet the changing patterns of education in Ceylon.

.02 Study of current standard plans

The difficulties with existing science laboratories, workshops, home economics units, library, toilets and single and double-storey teaching blocks is that they differ in cross-section and cannot therefore be joined one to the other. This means that in practice each unit is built quite separately on the school site. Water supply connections and electrical connections where provided become extended and expensive. Moreover, no advantage can be taken of common party walls, foundations and the like (Figure 5).

The first step is thus to examine the possibility of modulating the standard plans so that they can fit together.

Examination of the present units indicates, also, that there is a considerable waste of space in the planning arrangements. If laboratory and workshop and home economics units are all reduced in size, then not only is there a substantial saving in cost but a very real improvement in educational amenity. The two-storey teaching block contains 69.5% of useful teaching space, the rest of its covered area consisting of covered way and staircases. It is impossible to re-design this block to raise the teaching area to 80% of the gross covered area and to achieve consequent reductions in the cost per place.

This section is therefore devoted to a study of existing units and offers fresh ideas on design. Background material on the body sizes of Ceylon children (on which the sizes of spaces depends) and on thermal comfort are given as annexures to the report (Annexures IV & V).

It is worth mentioning, at this stage, that, during 1967, the Institute is preparing a resource book of plans for science laboratories, home science units, workshops and agricultural teaching spaces, with the assistance of a series of eminent consultants in these fields. The comments and suggestions that follow may thus be the subject of some modification in the ensuing months, although the work of the consultants will be on the design of units for the region as a whole, rather than for Ceylon in particular.

A) Science Laboratory

i) Function

The function of the standard, single laboratory is to provide facilities for teaching Chemistry, Physics and Biology [7] to students preparing for examinations in these subjects at 'O' and 'A' level. As furnished

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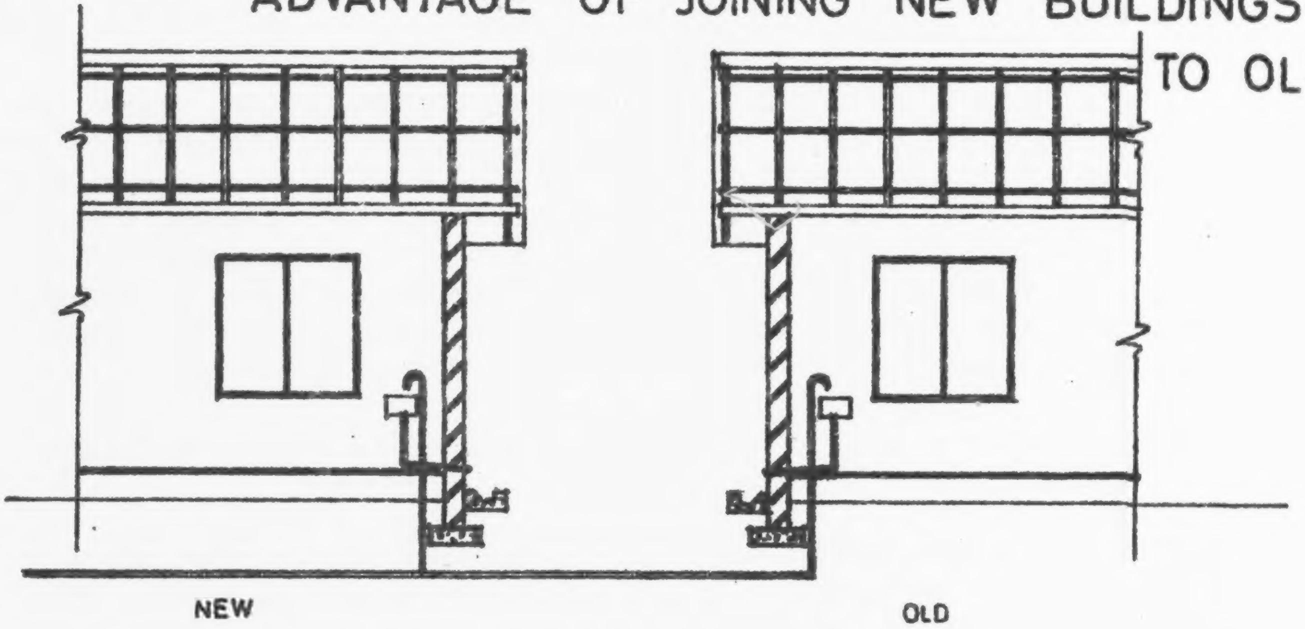
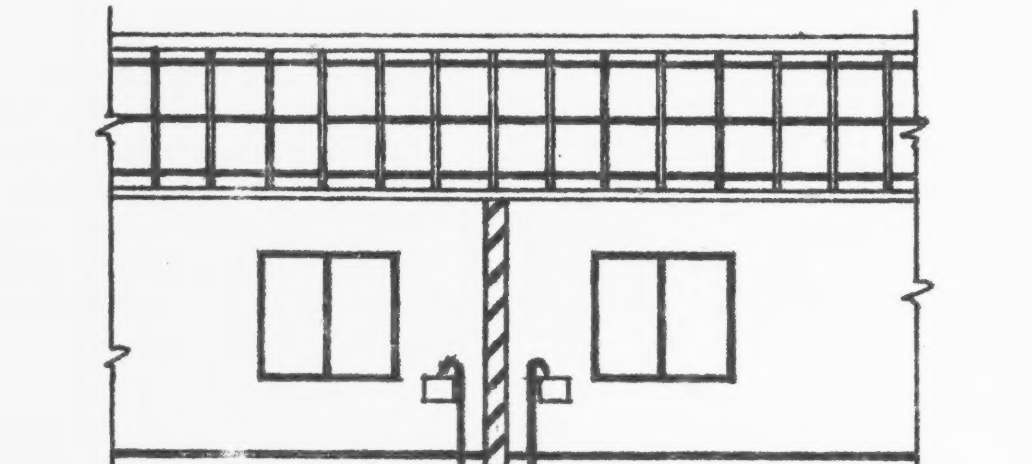
[7] Agricultural science would appear, from study of the syllabus to acquire a separate laboratory.

CEYLON SECONDARY GENERAL SCHOOLS ADVANTAGE OF JOINING NEW BUILDINGS TO OLD



(a) BUILT APART

2 walls
2 foundations
2 roof verges
2 cannels
long water supply connection



(b) EXTENDED

use existing wall
no verge
one foundation
short water connection

FIGURE 5

at present, the laboratory would accommodate a maximum of 30 students undertaking 'O' level work. In the six schools studied, the mean occupancy of laboratories was 27 with a range of from 13 to 34 students.

ii) The Standard Plan

The single science laboratory with store and verandah is the most recent of a series of laboratories that have been developed in the Ministry. It is noteworthy that the trend in each successive design has been towards a reduction in size both of storage area and of teaching accommodation. The present laboratory (Figure 6) has an internal area of 725 sq.ft., the store is 81 sq.ft. and the verandah 200 sq.ft.

The nett teaching area per place is as follows:-

Occupied	by	13	students	...	56 sq.ft.
"	"	27	"	...	27 " "
"	"	34	"	...	21 " "

The gross area per place is as follows:-

Occupied	by	13	students	...	81.5 sq.ft.
"	"	27	"	...	39 " "
"	"	34	"	...	31 " "

Of the gross covered area of 1006 sq.ft., only 68.5% is useful teaching space.

As far as thermal comfort is concerned the front benches and the teacher demonstration bench are not well located as cross-ventilation is partially obstructed by the store which is at the side, rather than at the end of the laboratory. In section, the windows are 4'0" high at cill level and the effect of this on ventilation is shown in Figure 7. The louvred openings, already too high in relation to the standing height of the Ceylon child, have the effect of directing the flow of incoming air still higher towards the ceiling. No low-level ventilators are included so that cooling through "stack effect" in areas where breezes do not occur, is impossible.

Illumination levels were not systematically plotted in the schools visited but from the few readings taken it is clear that they will be low in the centre of the room and on that side of the room adjoining the verandah. An illumination curve of the type shown in Figure 8 may be anticipated and, on an overcast day, it is unlikely that the level on the benches would exceed 7 and 8 lumens per sq.ft; 10 lumens per sq.ft is regarded as an absolute minimum standard.

CEYLON SECONDARY GENERAL SCHOOLS CURRENT STANDARD PLAN FOR SCIENCE LABORATORY

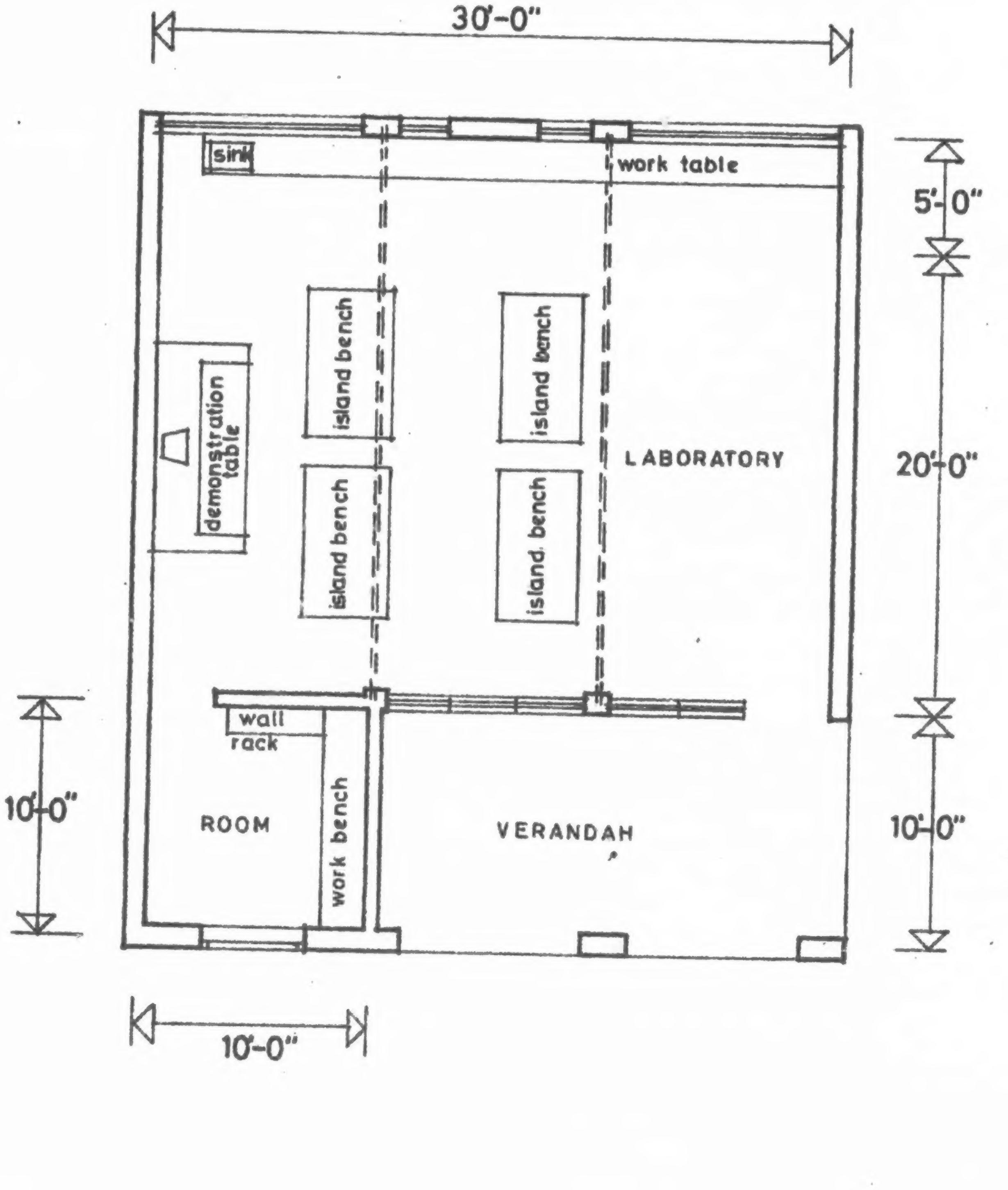

30'-0"
sink
work table
5'-0"
island bench
island bench
demonstration table
island bench
island bench
LABORATORY
20'-0"
wall rack
10'-0"
ROOM
work bench
VERANDAH
10'-0"
10'-0"

FIGURE 6

CEYLON SECONDARY GENERAL SCHOOLS
EXISTING STANDARD LABORATORY
AIR MOVEMENT SHEWING
DIFFICULTIES OF VENTILATION
FOR COOLING

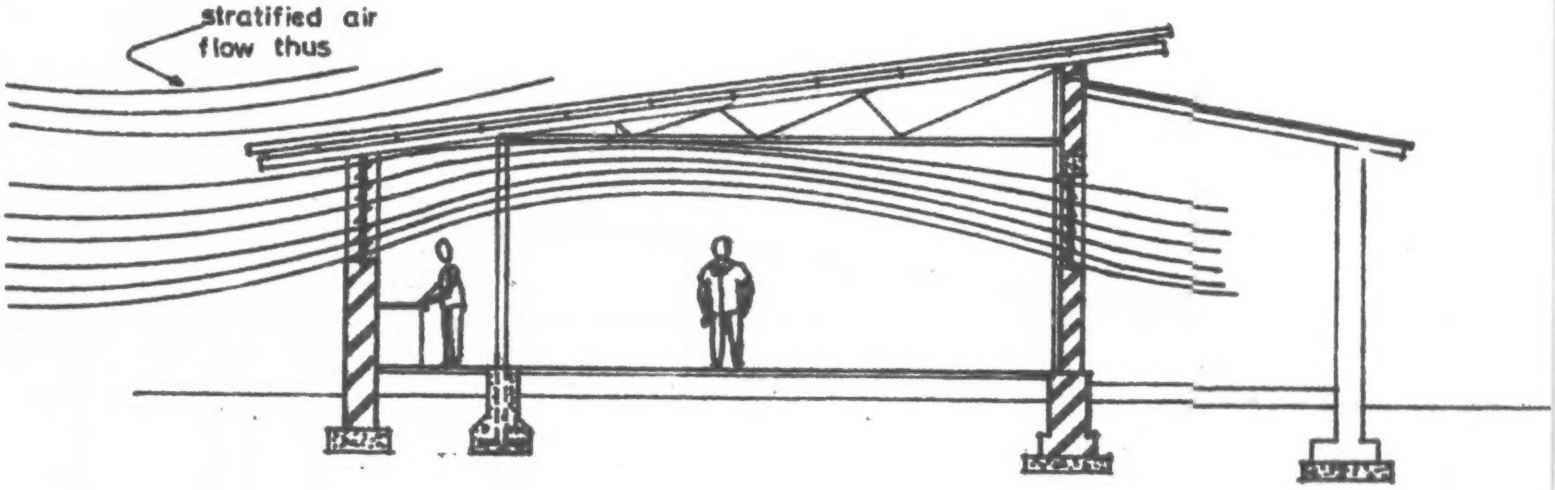

stratified air flow thus

FIGURE 7

CEYLON SECONDARY GENERAL SCHOOLS EXISTING STANDARD LABORATORY ILLUMINATION CURVE

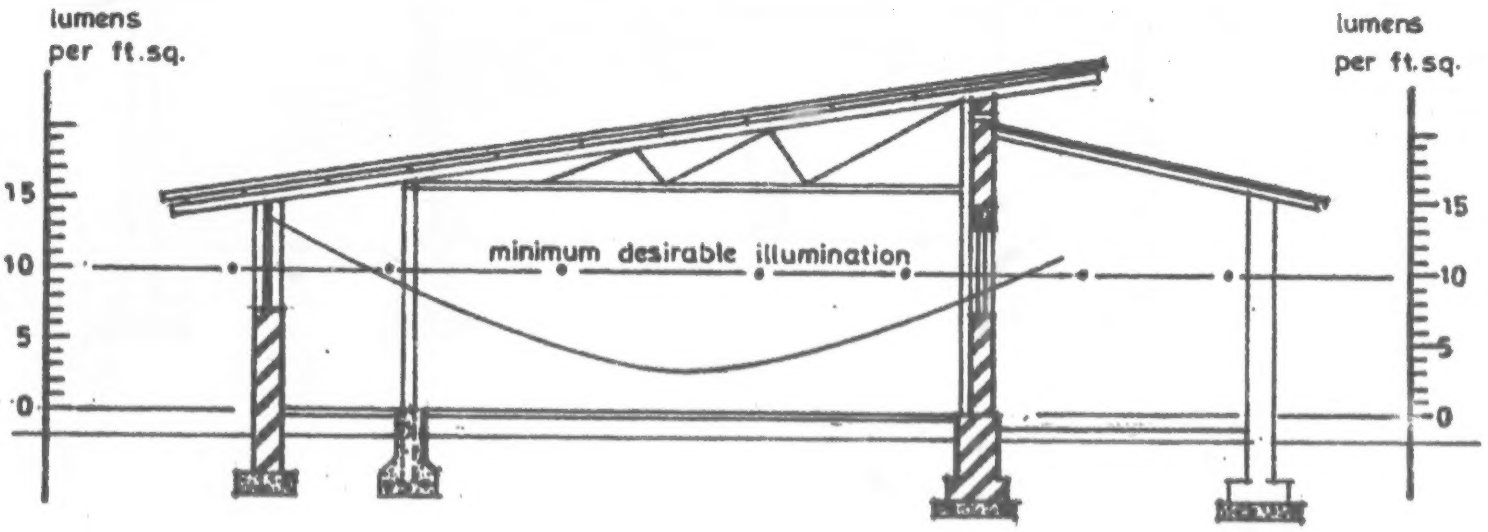


FIGURE 8

Structurally the standard plan is needlessly complex. The columns in the teaching space are not required if a simple light-weight timber roof truss is used to carry the roof load of either clay tiles or asbestos sheets over a span of 25 sq.ft. The double, lean-to type roof causes awkward junctions with walls that are difficult to waterproof and several of the laboratories visited were found to leak in rainy weather due to failures at these junctions.

Finally, the location of island benches in the middle of the floor needlessly poses problems of distribution of water, gas and electricity supply and drainage. Underfloor ducting is necessary and this not only expensive but can be inconvenient for cleaning of channels and maintenance of service connections.

iii) Adjustments to the standard plan (see Plates 1 & 2)

The trend towards smaller laboratories mentioned above is continued in this suggested adjustment to the standard plan. This plan has been compactly arranged advisedly and for the following reasons:-

a) The present laboratory is, and will be for sometime to come, far too large for schools in remote areas with small science populations.

b) In urban areas and in other places where science teaching is rapidly developing, there is a need to provide separate laboratory space for the three sciences, chemistry, physics, and biology and/or separate spaces for 'O' level and 'A' level classes.

Clearly the larger and more expensive the standard laboratory, the greater will be the difficulty in finding money to bring about these building developments. There is thus a strong case for the design of a very compact laboratory unit which will be suitable for the smaller teaching groups of the rural areas and cheap enough to add to existing laboratory accommodation in the urban areas where there is the need for more than one unit in a particular school.

The following adjustments will improve the standard plan from a functional view point (and also reduce its cost - see Section 2.08 on costs):-

a) Reduction in area of teaching space to 424 sq.ft. giving 26.5 sq.ft. per place for an 'A' level class of 16 students and 14.2 sq.ft. per place

CEYLON SECONDARY GENERAL SCHOOLS SCIENCE LABORATORY

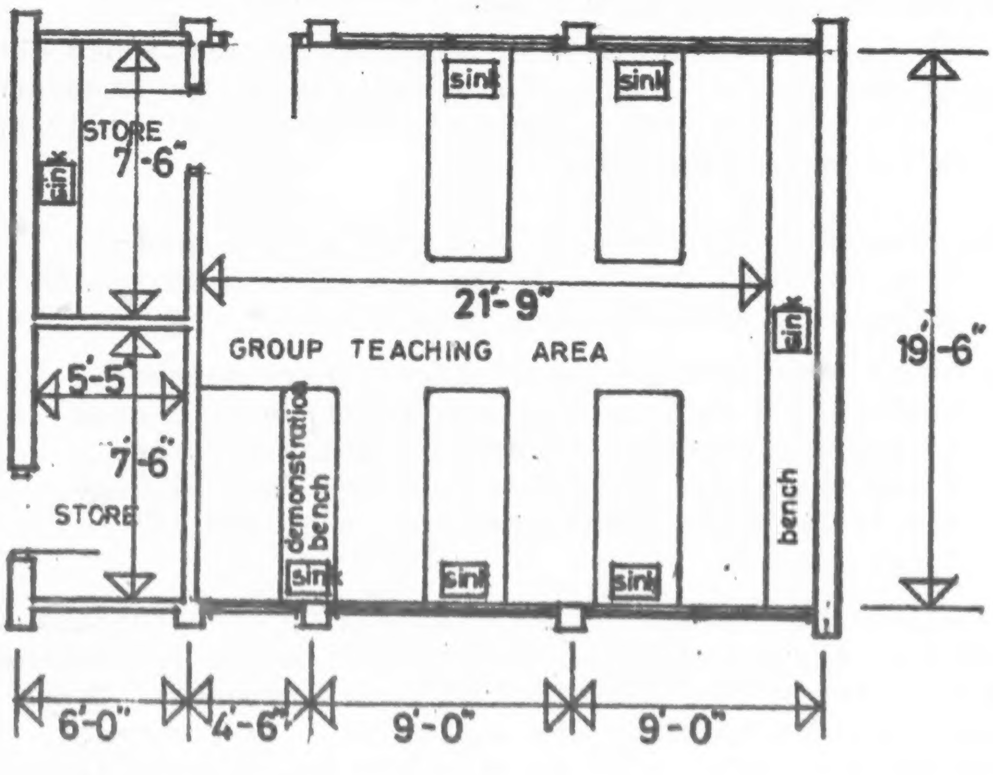

STORE
7'-6"
sink
sink
sink
21'-9"
GROUP TEACHING AREA
5'-5"
7'-6"
STORE
demonstration bench
sink
sink
sink
bench
sink
19'-6"
6'-0"
4'-6"
9'-0"
9'-0"

FIGURE 9

for an 'O' level of 30 students (see Figure 9) the arrangements suggested will provide for six students per wall island bench and six at the wall bench for 'O' level work and four students per island bench for 'A' level work. The anthropometric data in Annexure IV indicates a bench spacing of 3′0″ to be very adequate.

Benches are 7′ 6″ long giving a length per place of 2′6″ for 'O' level students and 3′9″ for 'A' level. *Simplification of construction* is achieved by the use of a normal pitched roof spanning 20′0″ without internal columns and without awkward wall junctions.

(b) **Improvement of thermal comfort**

Cill levels, should be lowered to bench-top height and honeycomb brick or block-work should be built close to floor level to induce stack-effect ventilation in areas where breeze is reduced due to external obstructions. Side-hung windows are suggested to avoid the upward deflection of breeze blowing through the building.

(c) **Improvement of illumination**

This occurs because of the reduction in the width of the building, lowering of cill levels, and the location of benches close to the windows instead of in the centre of the laboratory.

(d) **Simplification of service** is possible due to location of sinks on external walls with direct disposal to external, open channels. Power, gas and water can also be run along the inside of external walls, with good access for repair and adjustment.

The adjusted plan is shown in Plates 1 & 2.

(e) **Addition to existing units**

The standard single-storey classroom block has a span of 20′0″ (c/c[a/] of piers). The proposed new science room has been arranged to be a similar width. When a new laboratory is required it can thus be either constructed inside an existing classroom or added to the end of an existing block. This will avoid the very considerable expense of constructing a separate building, the cost of long pipe runs and the inconvenience of moving a class of children across the site to the laboratory in inclement weather.

[a/] c/c = Measured from centre to centre

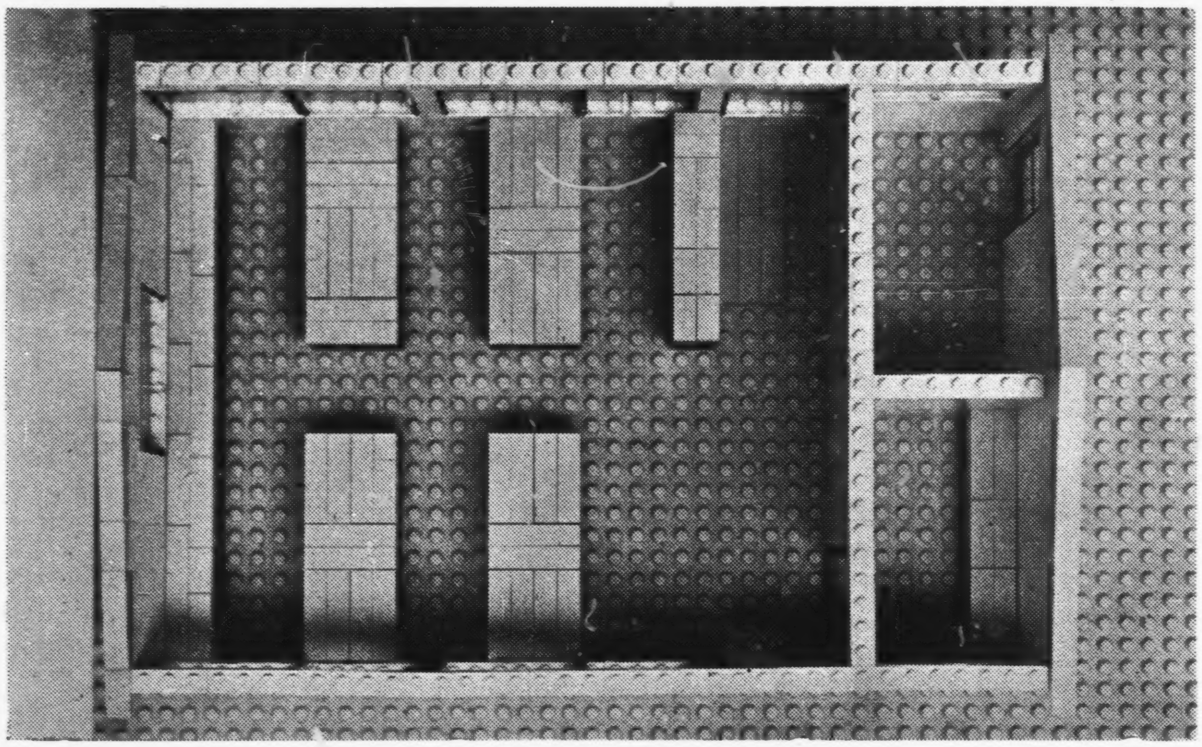


Plate 1 Plan view of adjusted Science laboratories

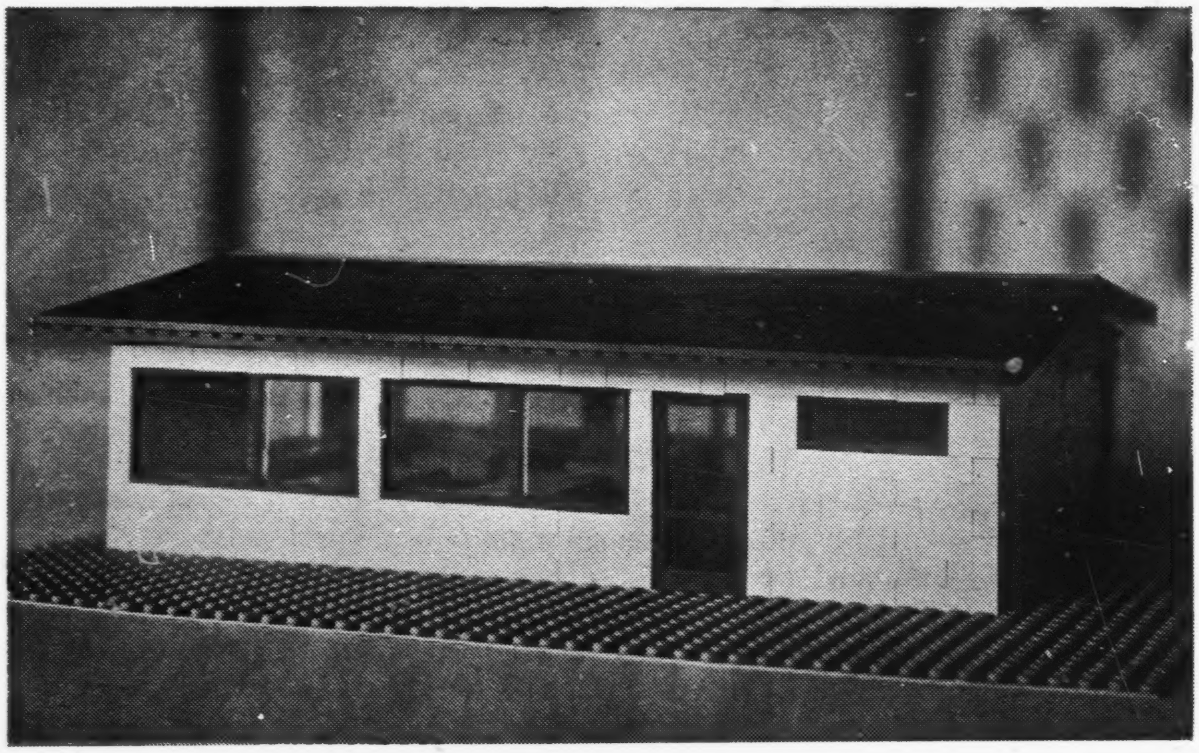


Plate 2 View of adjusted Science laboratory

B) Workshop Unit

i) Function

The function of the standard, double workshop unit is to provide facilities for teaching workshop crafts of a varying nature, depending on the school and its location. The crafts include woodwork, weaving, ceramics and metal work. In many cases the combination observed was woodwork in one shop and ceramics with weaving in the other. Occasionally **metalwork** and woodwork are also combined.

A single workshop could provide space for either ten double woodwork or metalwork benches (20 student), or four looms and ancillary equipment, or pottery wheels and tables and kiln.

Most workshops visited were not furnished to capacity and there appeared to be much unused space.

ii) The Standard Plan

The workshop unit comprises two **workshops**, each 35'3" x 19'3" between which are two "stores" each 11'3" x 9'3" (Figure 10). In every unit visited, the stores were used as teachers' rooms and materials that should have been in the store were kept on the floor of the workshop.

Analysis of the unit is as follows:-

Total area of workshop space (in 2 shops) = 1350 sq.ft.
Nett teaching area per place (assuming 40 places - 20 in each shop) = 34.0 sq.ft.
Total area of workshops and stores (83'3" x 19'3") = 1603 sq.ft.
Gross area per student place (40 students) = 40.6 sq.ft.

Thus, of the total covered area some 83% is useful teaching space and 17% is storage.

As far as thermal comfort in the workshops is concerned there were many complaints made in the schools visited. Improved cross ventilation will resolve this difficulty. At present, as is the case in science laboratories, cill heights are such that any breeze entering the building will flow across at head level or higher. "Stack-effect" cooling is impossible due to the absence of low-level air inlets.

CEYLON SECONDARY GENERAL SCHOOLS CURRENT STANDARD PLAN FOR WORKSHOPS

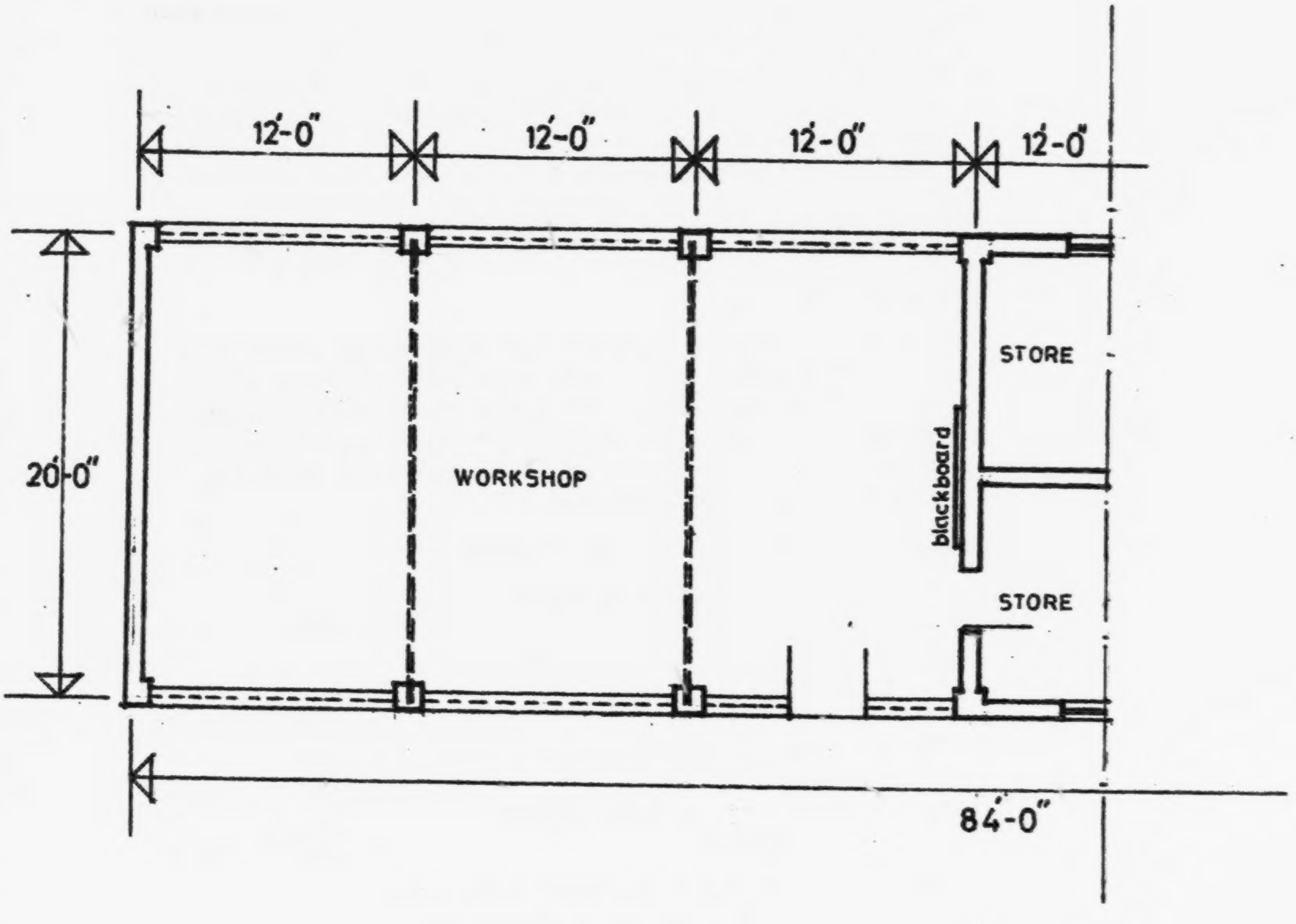

12'-0"
12'-0"
12'-0"
12'-0"
20'-0"
WORKSHOP
STORE
blackboard
STORE
84'-0"

FIGURE 10

Illumination could be improved through painting with light colours. The rusted wire at the window openings, coupled with the dark colour of the ageing asbestos ceiling, gives very low internal reflectance.

The shape of the workshops - rather long and tunnel-like is not efficient from the viewpoint of either students or teacher. Construction of association charts for movement within the shops indicates that students farthest from the store will waste far more of their own time and that of the teacher in one period than those closer to the front of the shop.

Finally the stores themselves are too large and, as far as woodwork or metalwork are concerned, it is not possible easily to manoeuvre a long length of steel or timber in through the door.

iii) Adjustments to the Standard Plan

The following adjustments to the standard plan (Figure 11) will improve it from a functional view-point (and also reduce its cost - see Section 2.08 on costs):-

a) Change of shape

Association chart studies show clearly that a shape approaching a square is **not** suitable for workshops. The revised workshop plan is thus 25'6" wide (c/c piers) and the overall length of one shop and store is 26'8" (c/c walls).

Double benches with vices at opposite ends are not economical of space and the revised plan incorporates 5 benches, square in shape and with vices on alternate corners. This provides for 20 student places.

The two workshops are not divided by a wall as this would serve no useful purpose. The space created by omitting the wall is useful and allows more flexibility in planning activities within the shop. (Plate 3a) and (Plate 3b)

CEYLON SECONDARY GENERAL SCHOOLS DOUBLE WORK SHOP

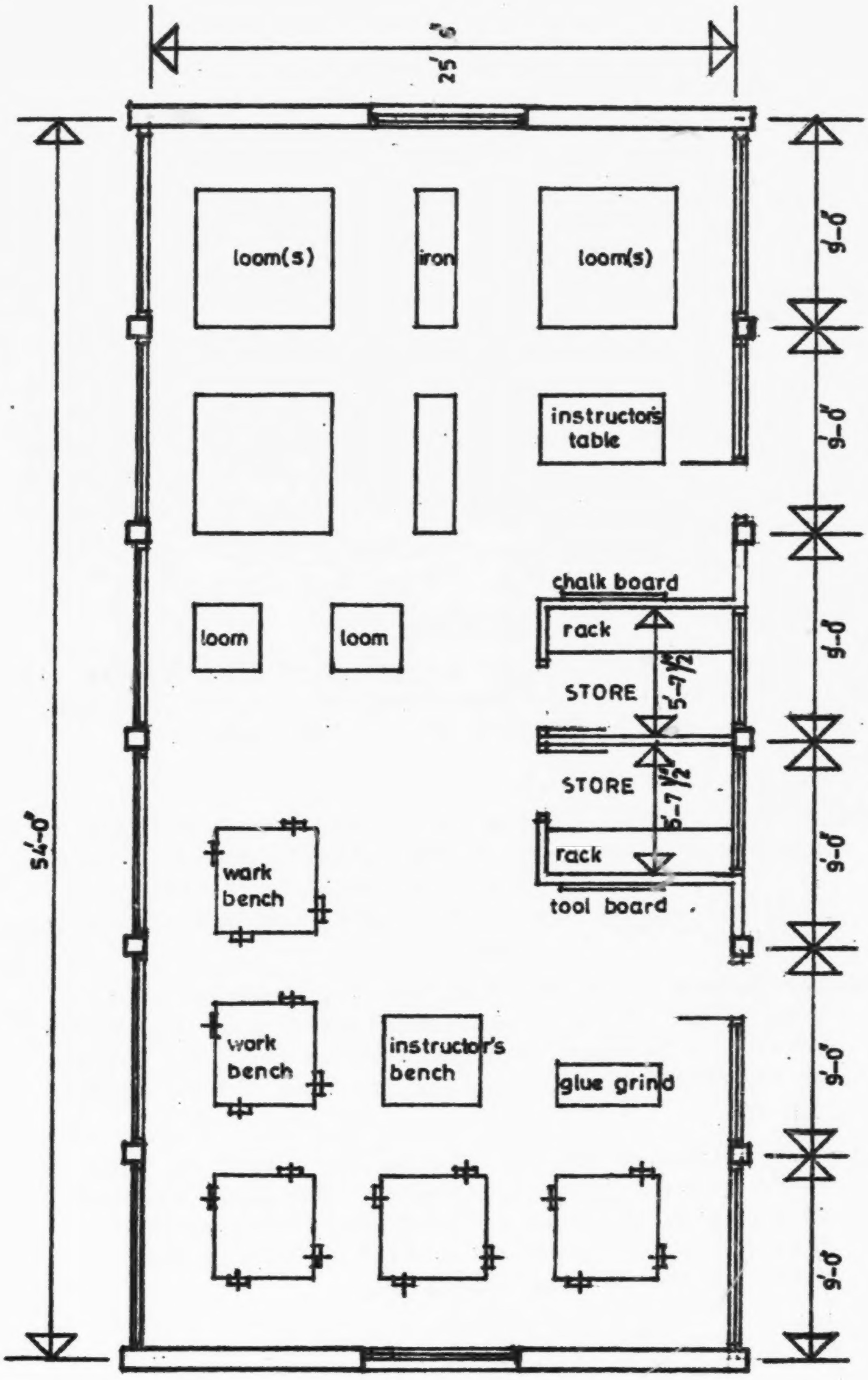

25'6"
loom(s)
iron
loom(s)
instructor's table
chalk board
rack
STORE
5'-7½"
STORE
5'-7½"
rack
tool board
loom
loom
work bench
work bench
instructor's bench
glue grind
54'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"

FIGURE 11

(b) Reduction in area

The revised workshop plan provides the following accommodation :—

(Figures in brackets give equivalent data for the existing standard plan).

Total area of workshop space in 2 shops	=	1250 sq. ft. (1350)
Nett teaching area per place assuming 40 places (20 in each shop)	=	31.2 sq. ft. (34)
Total area of workshops and stores	=	1365 sq. ft. (1625)
Gross area per student place	=	34.4 sq. ft. (39.5)

Thus of the total covered area, some 91.5% (83%) is useful teaching space and 8.5% is storage.

The total saving in area is 269 sq. ft. (16%)

Anthropometric studies coupled with experience in this matter, indicate that 4′ 6″ x 4′ 6″ benches with 3′ 0″ clear spaces between, provide adequate facilities for woodwork and metalwork for secondary general school curricula.

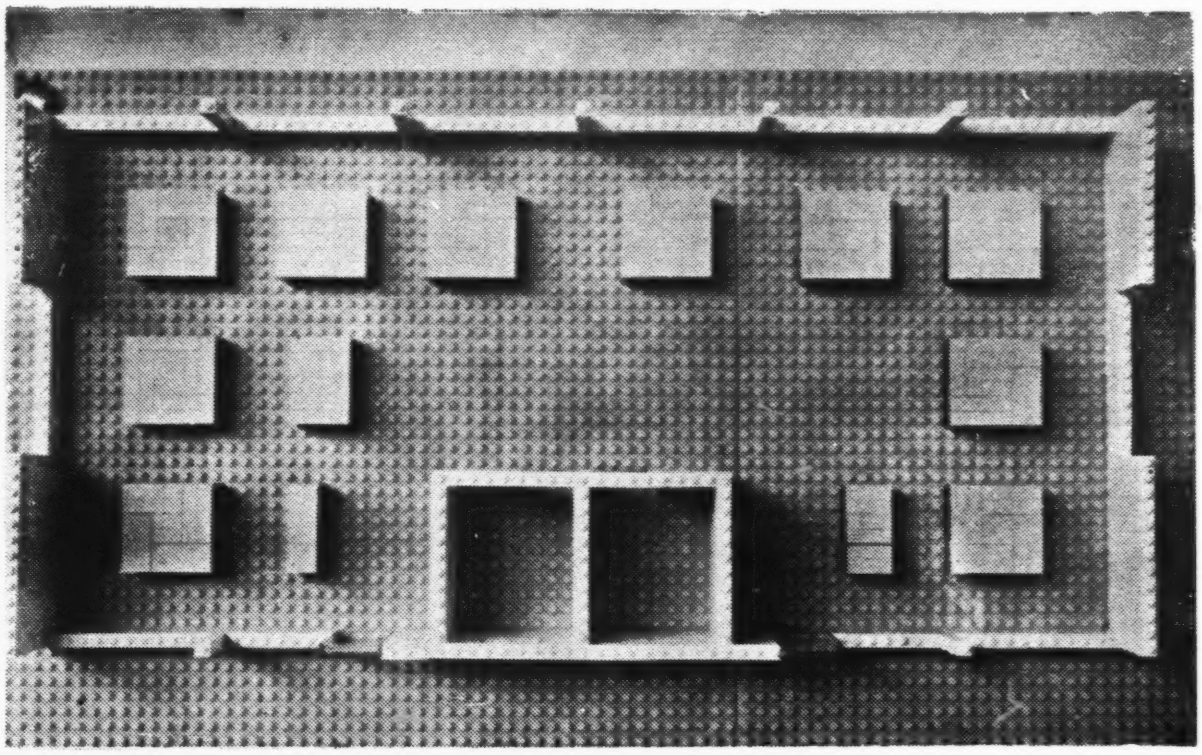


Plate 3a Plan view of adjusted workshop

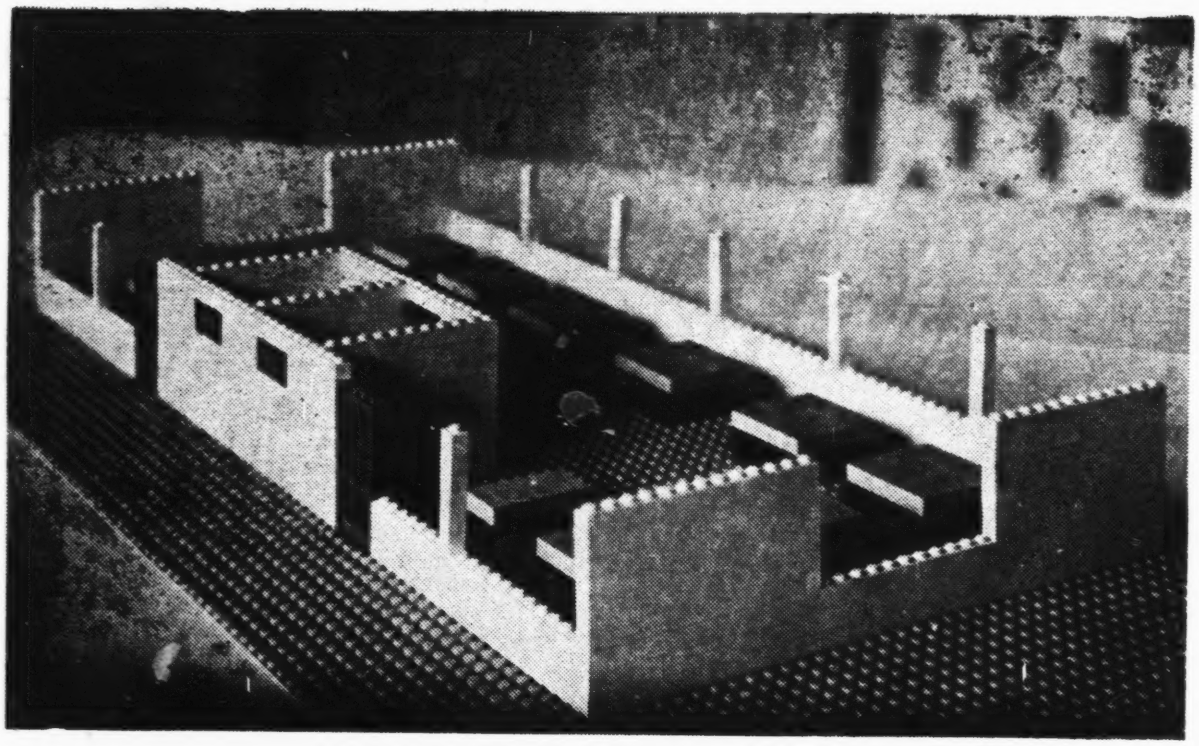


Plate 3b View of adjusted workshop

(c) Improvement of thermal comfort

The increased span has the effect of raising the general level of the middle of the roof and of reducing the possibility of warming from the underside by re-radiation. Stack ventilation provided through low-level openings will also improve thermal comfort conditions, especially in locations where free flow of breeze through windows is unlikely, due to obstruction caused by adjacent buildings and trees.

Lowered cill levels will ensure that, where breezes can blow through the workshop, the effect will be felt by the occupants.

(d) Illumination

Although the building is greater in width than the standard workshop, illumination levels on the benches will not be lowered as they are located around the walls of the shop. What is important however is regularly to maintain white or very light colour washes to the surfaces of the walls and underside of the roof in the building.

C) Home-Science Block

i) Function

The function of the standard, home-science block (Figure 12) is to provide facilities for teaching nutrition, textiles, household management and child development to groups of 20 girls.

The standard home-science block plan and one recently constructed unit have been studied, together with a number of ad-hoc units located in rooms intended for use as classrooms.

ii) The standard plan

The standard plan comprises one space with internal dimensions 30'0" x 35'9". This space is sub-divided by cupboards into three areas marked as laundry, ironing and sewing, work kitchen and sick room. The cupboards appear to provide adequate storage space and there is no separate store. Although the span of the roof is only 30'9", three steel stanchions are located in the middle of the block, presumably to assist in providing support.

Analysis of the unit is as follows:-

Total area = 1200 sq.ft
Area per place (20 places) = 60 sq.ft

There is, in addition, 360 sq.ft. of uncovered terrace for drying laundry.

It is of some interest to examine the layout of the home-science block in relation to the functions it is required to perform.

For teaching all sections of the home-science syllabus, it is necessary to provide a small laboratory facility. Laboratory experiments form a substantial section of the work to be done. No facility for this purpose is available in the standard block.

The Cultural Aspects of Food Preparation and the Household Management Sections of the syllabus both require an area in which to arrange furniture. and to select and prepare material for dining. No adequate space is provided in the standard block for this purpose. The standard building is thermally uncomfortable as most of the cupboards have been arranged across the room thus effectively blocking through ventilation.

As in the science laboratory, construction has been needlessly complicated by the placing of steel stanchions in the middle of the floor to support a roof, the span of which is only 30'9".

CEYLON SECONDARY GENERAL SCHOOLS CURRENT STANDARD PLAN FOR HOME SCIENCE

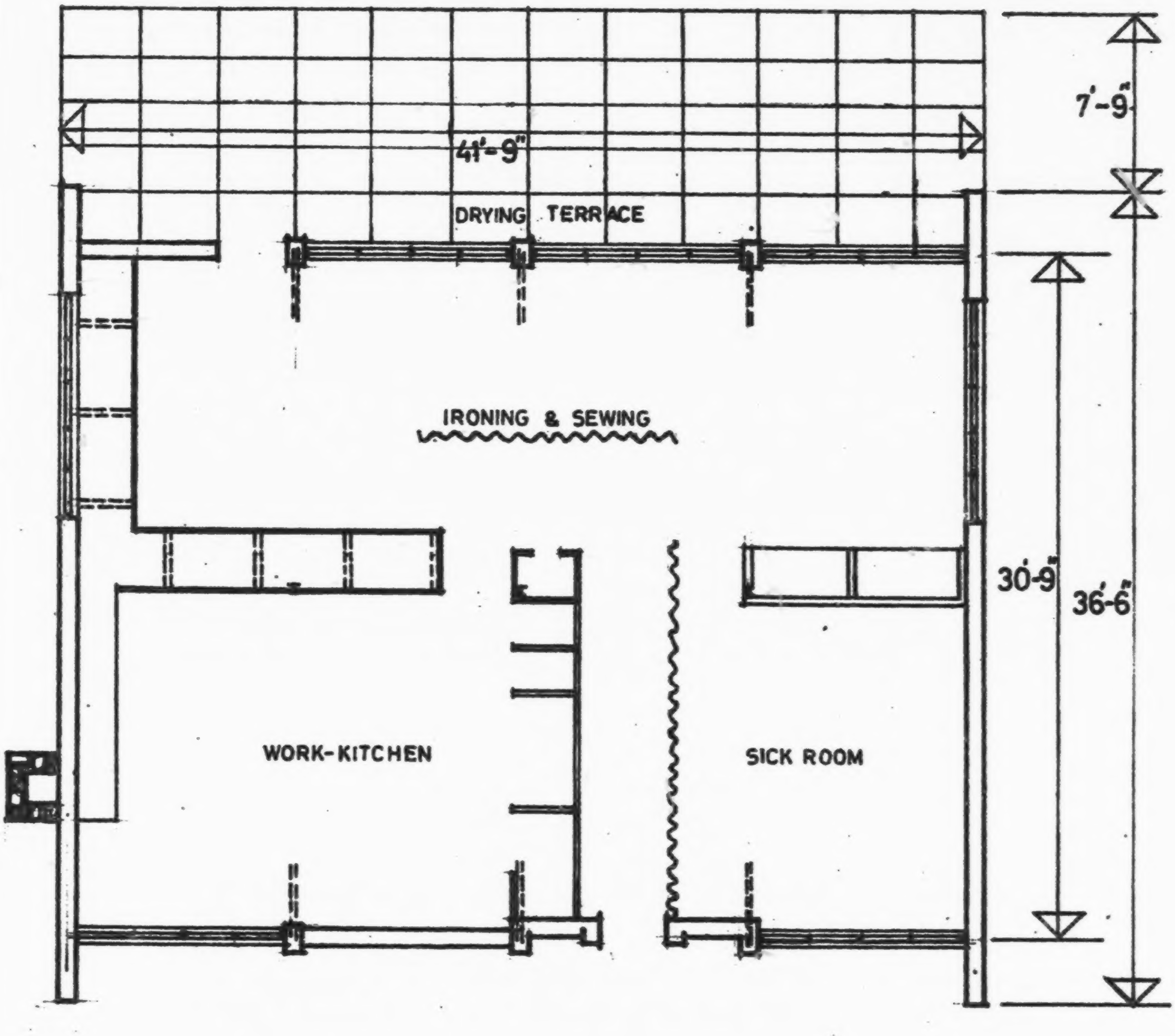

7'-9"
41'-9"
DRYING TERRACE
IRONING & SEWING
WORK-KITCHEN
SICK ROOM
30'-9"
36'-6"

FIGURE 12

CEYLON SECONDARY GENERAL SCHOOLS
ADJUSTED HOME SCIENCE UNITS

s = sink
c = cooker
bd = bed
ct = cutting table
tt = teacher's table
ib = ironing board
ib & cpd
= ironing board & cupboard
sm = sewing machine
cpd = cupboard
wt & cpd
= work top & cupboard

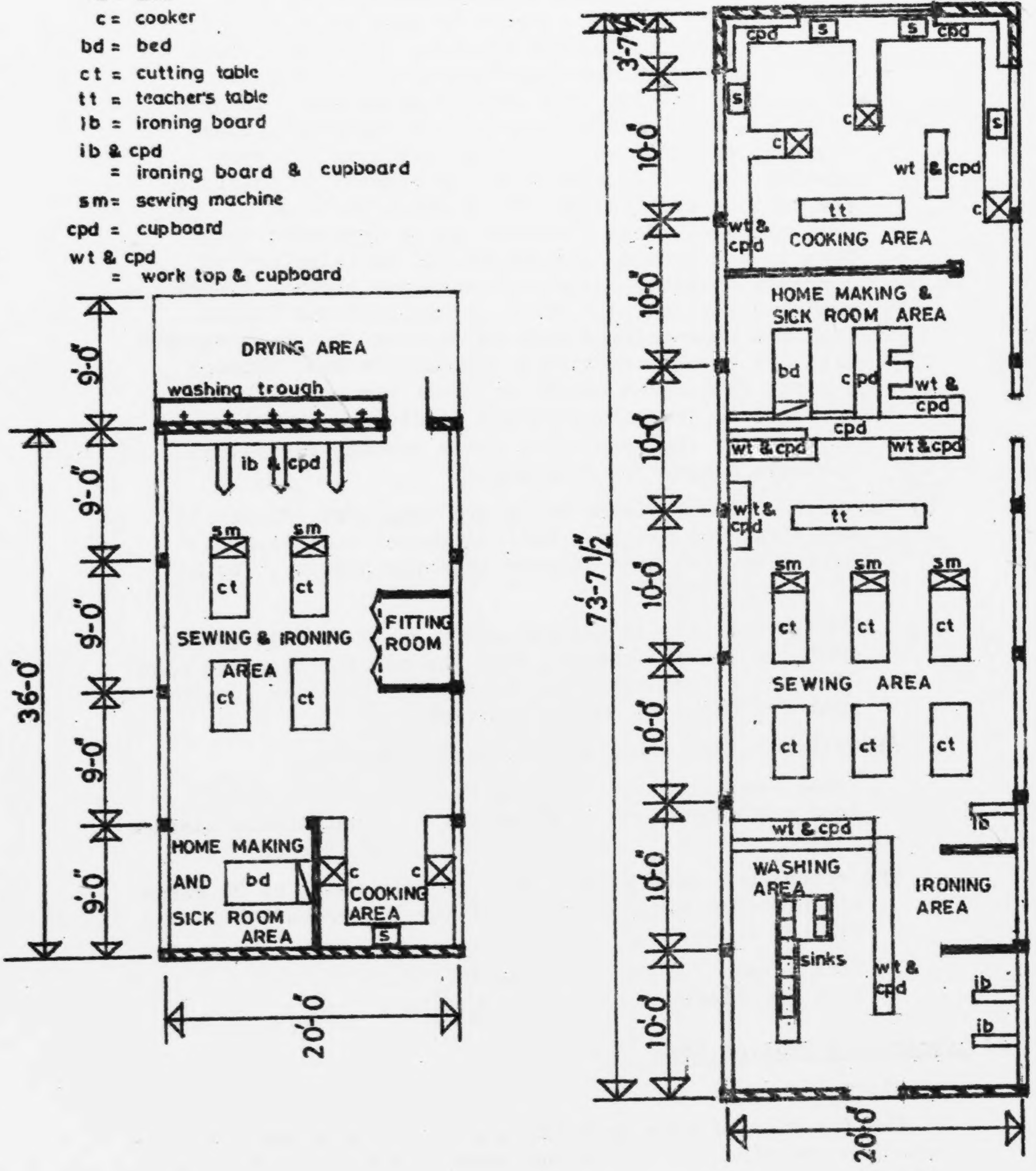

DRYING AREA
washing trough
ib & cpd
sm
ct
SEWING & IRONING AREA
FITTING ROOM
HOME MAKING AND SICK ROOM AREA
bd
c
COOKING AREA
s
9'-0"
36'-0"
20'-0"
cpd
s
c
wt & cpd
tt
wt & cpd
COOKING AREA
HOME MAKING & SICK ROOM AREA
bd
cpd
wt & cpd
SEWING AREA
wt & cpd
WASHING AREA
sinks
IRONING AREA
ib
3'-7½"
10'-0"
73'-7½"
20'-0"

FIGURE 13

iii) Adjustments to the Standard Plan

a) Clearly in teaching home science, the building, its furniture and fittings should be such as to form a good visual aid for the teacher. From this viewpoint, the design and detailing of a home science unit should receive very special attention. In some countries the home-science unit is built as a house slightly modified to facilitate teaching but presenting the children with an opportunity to practice the various sections of the syllabus in "live" surroundings. This, however, is an expensive solution to the problem and not wholly satisfactory as rooms of domestic scale and character are not always useful for teaching. It is recommended for Ceylon that the home-science unit be designed to be integrated with the normal teaching accommodation and, through careful design and detailing, that the spaces be arranged to simulate domestic conditions whilst at the same time providing those special facilities that are needed for teaching.

b) Two revised home-science units are suggested (Figure 13) the first for use in a well-developed urban school having several home science teaching groups at both 'O' and 'A' level.

The second plan is suggested for rural schools and is much simpler and cheaper than the current standard plan. It would be suitable for the smaller teaching groups that are found in such situations.

Analysis of the larger unit is as follows:

Total area - 1487 sq.ft.
Area per place - 25 sq.ft. (3 simultaneous classes of 20 each)

The second and smaller unit will house a total of 20 girls and provides the facilities of the larger unit but on a smaller scale.

Total area - 720 sq.ft.
Area per place - 36 sq.ft.

D) Library and Reading Room

Function

The function of this unit (Figure 14) is to house book preparation, reading, reference and lending facilities for the school's library. Classes may visit it formally from-time-to-time to learn how to use the facilities provided. The size of a library depends on the number of readers. The unit of

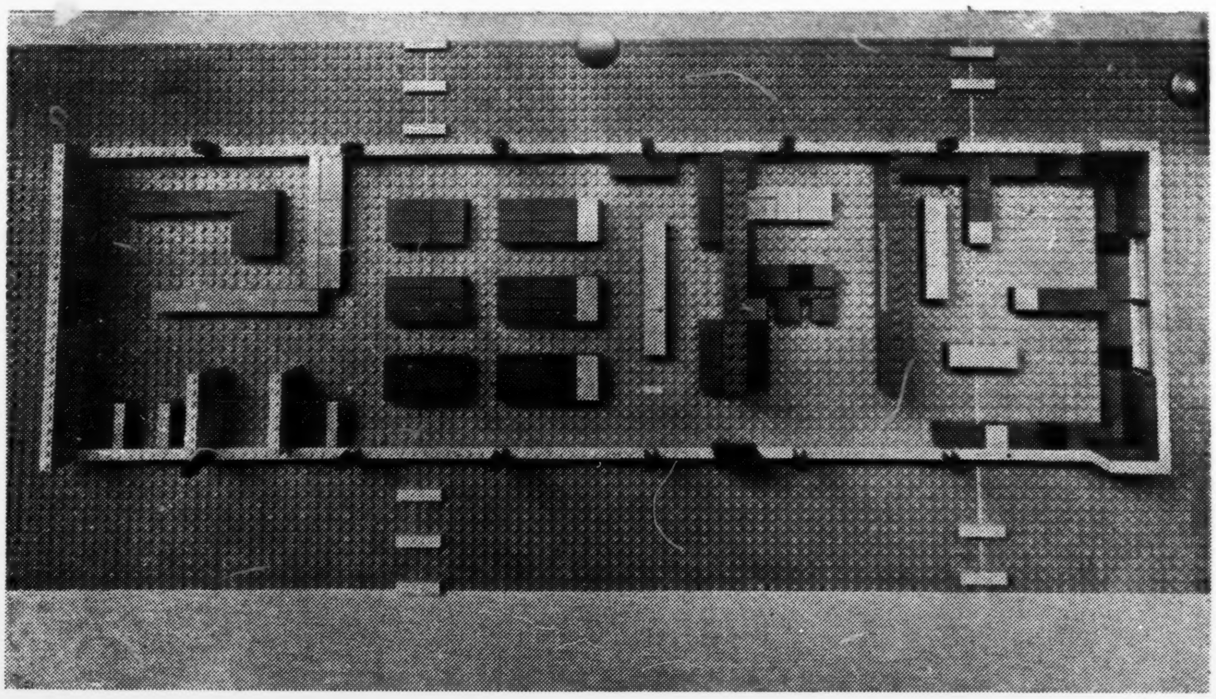


Plate 4 Plan view of adjusted home-science unit

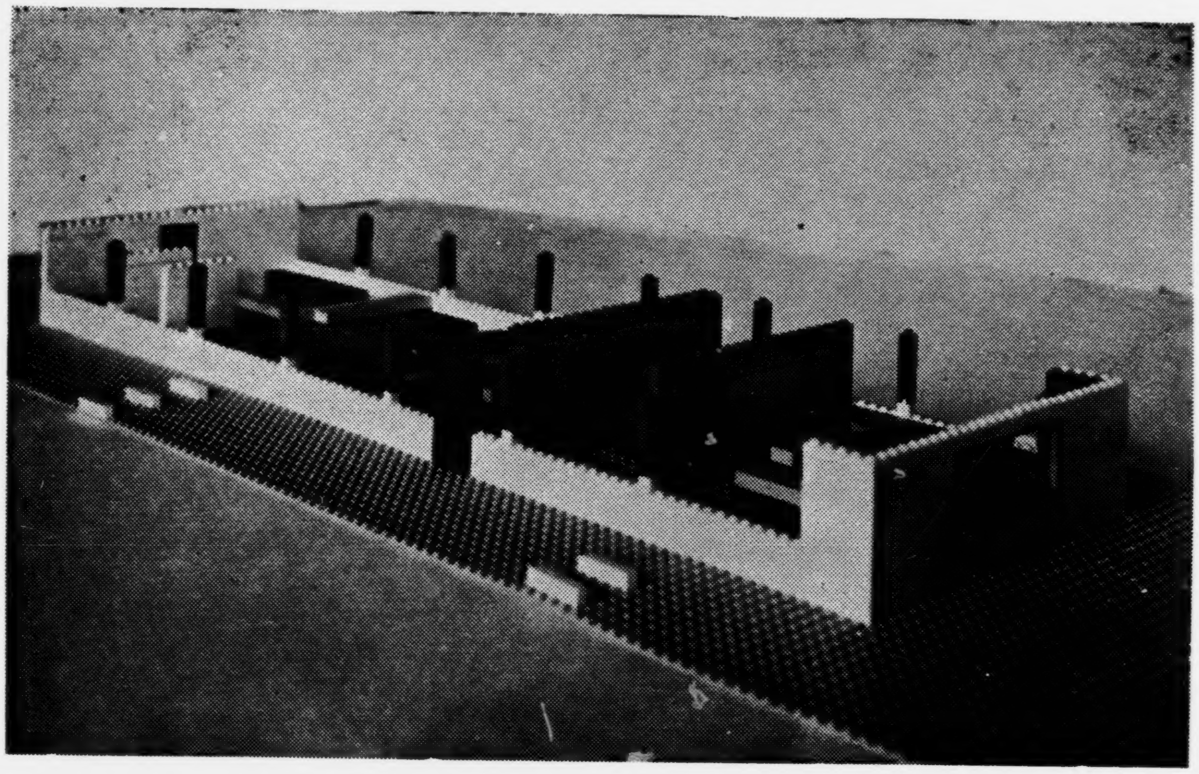


Plate 5 View of adjusted home-science unit

35' 0" x 20' 0" would probably hold nearly 7000 books and would seat about 30 readers. Normally, reading places are provided for 7% of the children in the school and in this case the library would satisfactorily serve a school population of about 430 students.

It may be that in some areas the library will have community use and if this is so there is, perhaps, an advantage in designing it as an independent unit. Apart from possible cheapening of the construction (mentioned elsewhere) the only change recommended to the present design is the incorporation of built-in shelving to standard 3'0" bay sizes as part of the building contract, and the provision of a work space to receive, unpack and prepare books for the shelves.

3.03 Study of Current Standard Plans for Classroom Accommodation.

The standard plans for classroom accommodation fall into two groups :—

(a) Single-storey, hall-type blocks varying in length from 4 to 14 bays.

(b) Multi-storey classrooms blocks of two or three stories with from 6 to 18 classrooms.

The drawings provided in the Institute in connection with this study were:—

Drawing No.	Date	Accommodation	Classroom Size ft.
SINGLE-STOREY			
424	1955	4 classrooms	20'0" x 20'0"
426	1955	3 classrooms	20'0" x 20'0"
427	1955	2 classrooms	20'0" x 20'0"
430	1955	2 classrooms, 1 store, 1 office	20'0" x 20'0"
656	1963	4 classrooms	24'0" x 20'0"
657	1963	6 classrooms	24'0" x 16'0"
661	1963	5 classrooms or assembly hall and stage, 2 dressing rooms (designed as an assembly hall)	30'0" x 16'0'
684	1966	6 classrooms, 2 stores (prestressed concrete, prefabricated panels)	20'0" x 20'0"

CEYLON SECONDARY GENERAL SCHOOLS
CURRENT STANDARD PLAN FOR LIBRARY

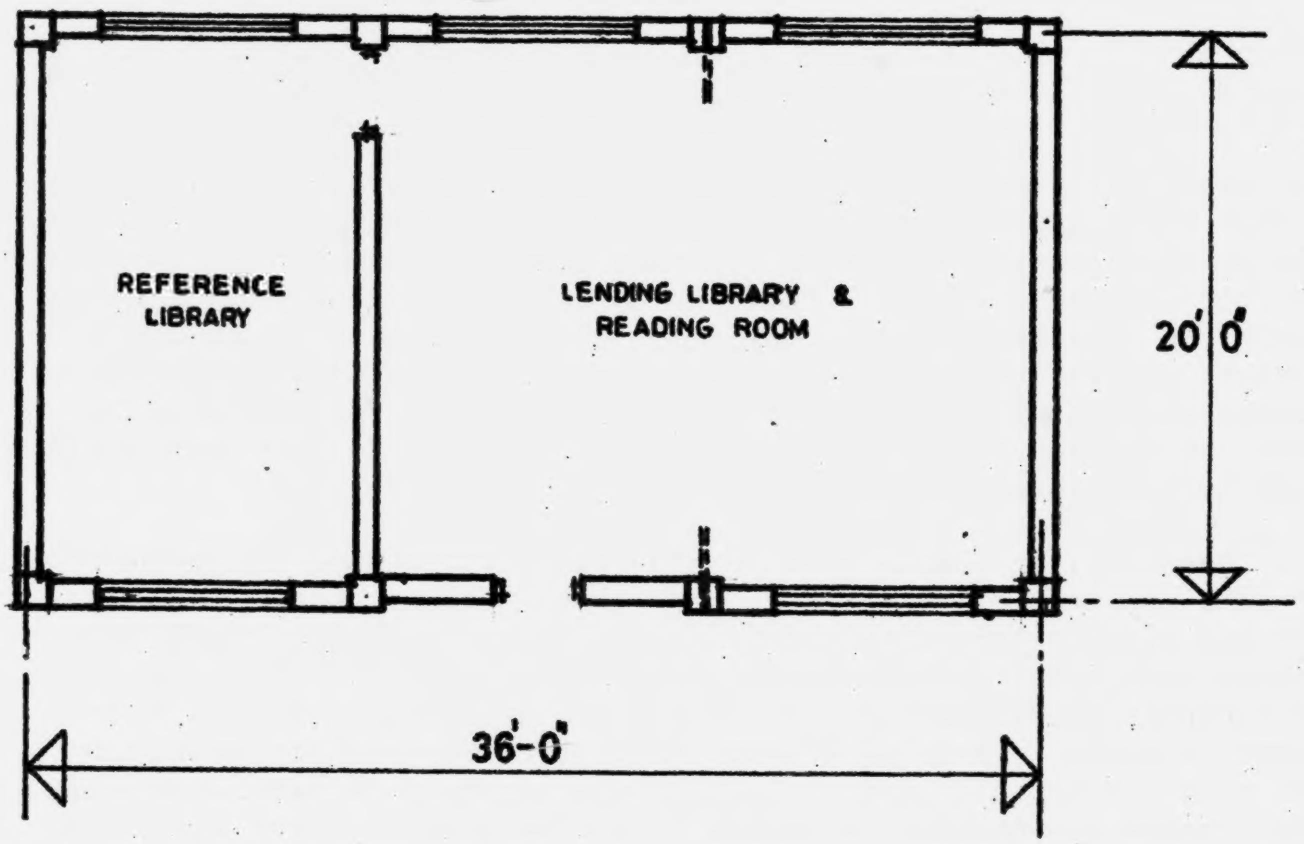

REFERENCE LIBRARY
LENDING LIBRARY & READING ROOM
20'0"
36'-0"

FIGURE 14

Drawing No.	Date	Accommodation	Classroom Size ft.
DOUBLE-STOREY			
538	1959	6 classrooms, 1 stair	24'0" x 20'0"
642	1963	7 classrooms, science laboratory, workshop, hall, 1 stair	24'0" x 20'0"
649	1963	4 classrooms 4 classrooms 1 hall, 1 stair	24'0" x 20'0" 20'0" x 12'0"
653	1963	16 classrooms, 4 science laboratories, 2 stairs, 4 stores	20'0" x 20'0"
689	1965	12 classrooms, 2 stairs	20'0" x 20'0"
691	1965	10 classrooms	24'0" x 20'0"
THREE-STOREY			
699	1966	18 classrooms, 1 stair	24'0" x 20'0"

The list itself raises several points of interest. Firstly, although the single-storey blocks are all of the same basic design, it has been necessary to provide separate drawings for what are essentially shorter or longer blocks. There is no indication that a 3-classroom block can be extended to 6 classrooms by the addition of another 3 bays of construction. This has encouraged the building of separate blocks at greater expense than would have been necessary had there been one drawing with the number of bays actually to have been built left to a decision by the regional building authority.

Secondly, in the 11 year period from 1955 - 1966, the pressures of land use have evidently been such as to require successively one, two and finally three storied buildings to be designed. These pressures will continue as populations increase and in 1977 it can be confidently predicted that Ceylon will be building four- and five-storey schools. There is a need, therefore, to consider expansion not only horizontally but vertically and it would be wise to arrange for present two-storied buildings to be designed to carry the one or two extra stories that may become necessary during the next decade.

3.04 Study of the current standard single-storey plans

The single-storey standard building is probably as simple a building as could be conceived. It comprises a long, undivided hall into which fit freely as many classes as can be conveniently seated. The accommodation thus possesses a degree of flexibility not found in classrooms with rigid permanent division walls. Smaller or larger groups can be accommodated simply by adjustments of furniture - chairs, desks and chalkboards.

From the viewpoint of the educationist the hall has many inherent disadvantages. Except for the end class spaces there is no wall space for pinning up visual aids. The building is not secure and teaching material could hardly be left out without risk of damage from weather or loss by theft. Absence of division walls causes visual distraction during teaching periods as children can see adjacent groups and moreover as several teachers talk at one time, noise becomes a real problem. It is evident that the hall creates no sense of pride in a class for its classroom. Furniture is frequently moved and becomes more rapidly damaged than would normally be the case in a closed teaching space.

These are serious disadvantages, and yet it is difficult not to observe that despite them, generations of children have received their education in open hall schools and the quality of education, judged by the results, seems high, compared with that in other countries.

To remedy the situation by advocating abandonment of the open hall pattern would be to recommend an increase in cost far beyond the present means of the country. What can be done however, is to suggest an adjustment which, whilst not a final solution to the problem, will greatly improve the situation in future buildings and which can, moreover, be applied to existing schools.

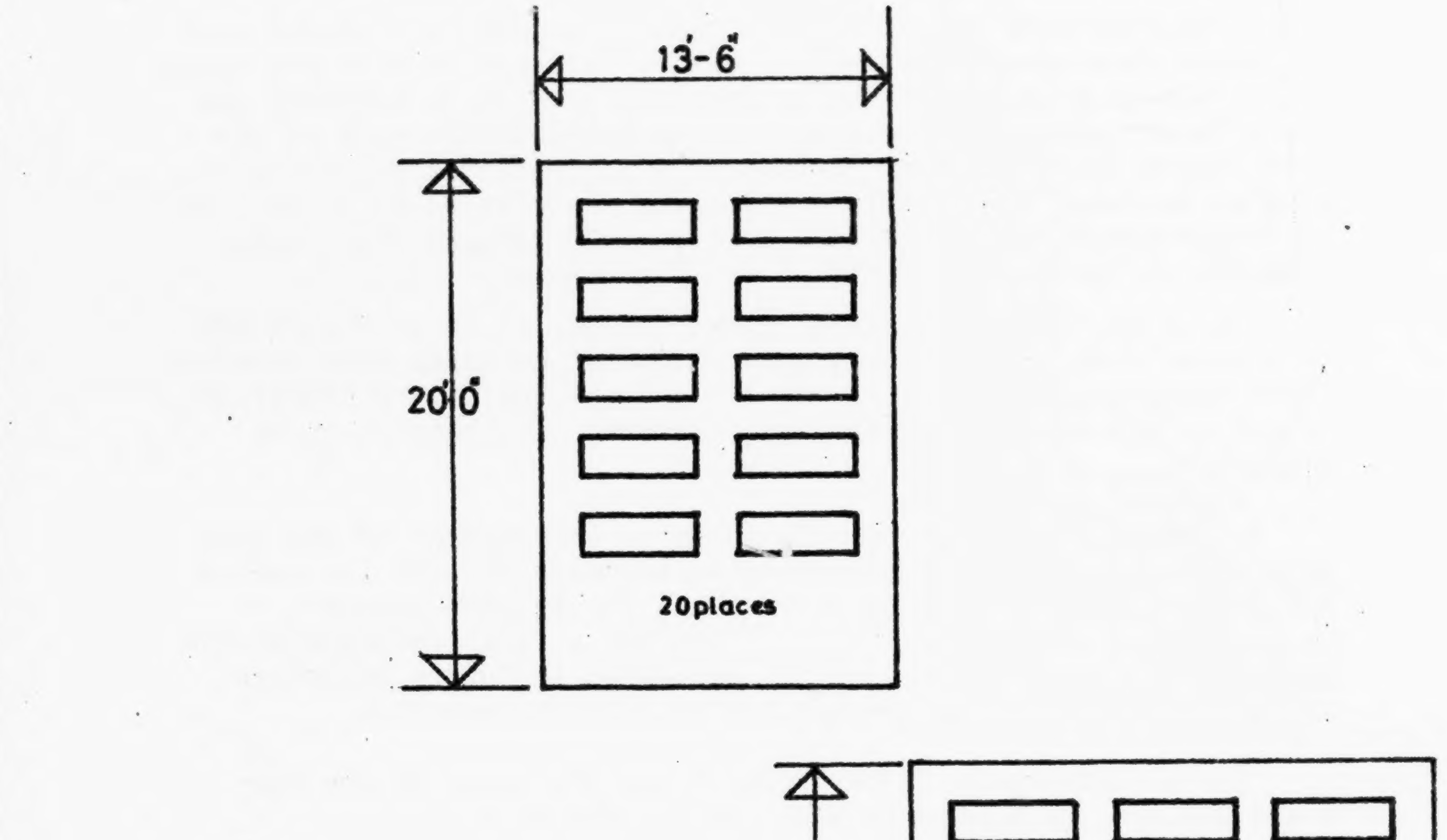
The adjustment is in the form of the provision of one cupboard and one chalkboard to each class. (Plate 6)

By linking two cupboards with a chalkboard, a division wall 14'0" long can be created. Soft board applied to the back of each cupboard will provide pin-up space for a small quantity of visual aid material and other teaching material can be locked in the cupboard facing outwards. The cost of this would be very small. In fact the use of this division will result in a small saving in future for easels will no longer be required and the number of chalkboards will be halved. Classes are already provided with chalkboards and many with cupboards. All that is required is a little carpentry work to link them together. The main space still remains flexible as the partition units can easily be moved.

3.05 Study of the current two-storey plans

The basic, two-storey plan comprises a 20'0" classroom with 8' 4 1/2" verandah outside on both ground and first floors. The function of the verandah is to provide for movement to and from the classroom between teaching periods. It is thus infrequently used; yet it comprises 30.5% of the area of the building. In the

CEYLON SECONDARY GENERAL SCHOOLS CLASSROOMS


13'-6"
20'0"
20places
18'-0"
20'-0"
27'-0"
20'-0"

24 places in 2 bays gives 15 sq.ft. place.

42 places in 3 bays gives 13 sq.ft. place.

FIGURE 15

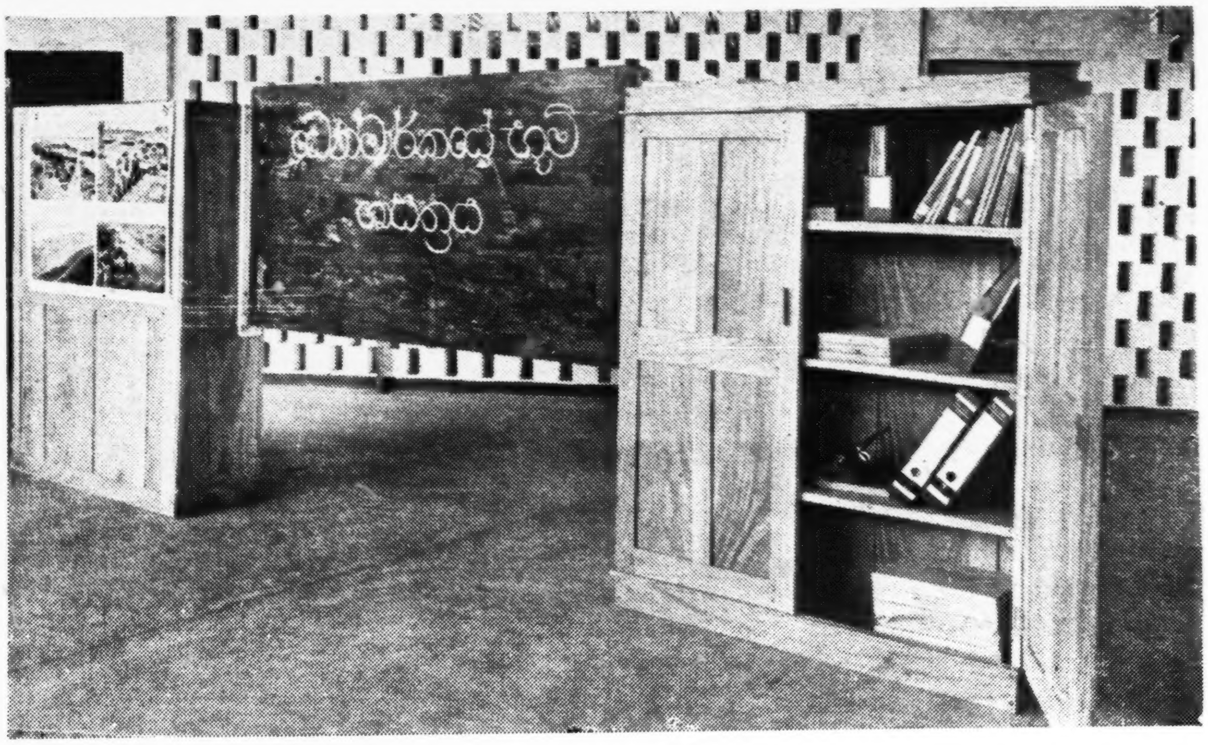


Plate 6 Division unit for hall schools using standard furniture

1965 Standard Plan 689, the total area of circulation space is 1000 sq. ft., enough covered area to have provided a further two large, and one small, classroom or to provide a principal's office, staff room, general office and staff toilets.

It is of course inevitable that circulation space be provided in all two-storey construction but rarely need this exceed 20% of the gross area of the building.

The second point arises in connection with the sizes of classrooms. These vary in the plans from 400 sq. ft. to 480 sq. ft. The width of 20′0″ is satisfactory but with a length of 20′0″ it is only possible reasonably to accommodate some 24 students. With a length of 27′0″ 42 places can be provided comfortably. (Figure 15) The ten-feet and 12 ft. bay sizes commonly used are rather too large to allow of flexibility. A smaller bay size of nine feet would still allow of 24 places in a two-bay class and three bays would seat 42 students. Nine-foot bays have the added advantage of reducing the size of structural elements in roof, walls, floors and foundations.

A further difficulty associated with the wide verandah used in the standard plan, is that of illumination. A 9′0″ projecting verandah on one side of a class effectively reduces the natural lighting on that side to a very low level such, in fact, that part of the room is quite dark. A reduced width of verandah would improve this situation.

Again with two storey buildings, no provision is made to add to existing blocks either vertically or horizontally. The result is a proliferation of individual blocks on one site with a consequent reduction of area for games and future building and all the attendant inconvenience in moving from one block to another.

It is encouraging to observe in one or two schools that science laboratories have been brought into the main block but it is understood this is a fairly rare occurrence.

3.06 Adjustments to the two-storey standard plans.

Two adjustments can be made to the design of double-storey schools to reduce the cost and improve amenity. These are: first, a straight-forward reduction in area of construction of the existing standard plans; and secondly, the design of new buildings incorporating not only classrooms, but also the other teaching spaces, now separately housed in individual units of construction.

(i) Economies and existing plans

The number of economies that can be achieved through re-arrangement of existing plans is limited only by the imagination of designers. However two examples of the ways in which space can be saved and cost reduced are given here. They all involve the production of drawings for a single block of 4 classrooms. (Figures 16, 17, 18 & 19.) If 8, 12 or 16 classrooms are needed in an actual situation then the standard block is simply multiplied as required. In Solution A, the width of corridor is reduced 5′ 0″ and occupies only 20′ 0″ in length. The staircase is under cover. In the Solution B, the 5′ 0″ corridors are reduced in length and the staircase is external. A comparison of the two solutions and of the standard plan solution is given below in Table VII.

TABLE VII: COMPARISON OF AREAS OF EXISTING AND ADJUSTED PLANS FOR TWO-STOREY BUILDINGS

(4 classrooms)

Unit	Gross Area	Area of Circulation	%age of Circulation
Standard Unit	2480	760	30.5
Alternative A	2243	443	19.6
Alternative B	2112	412	19.5

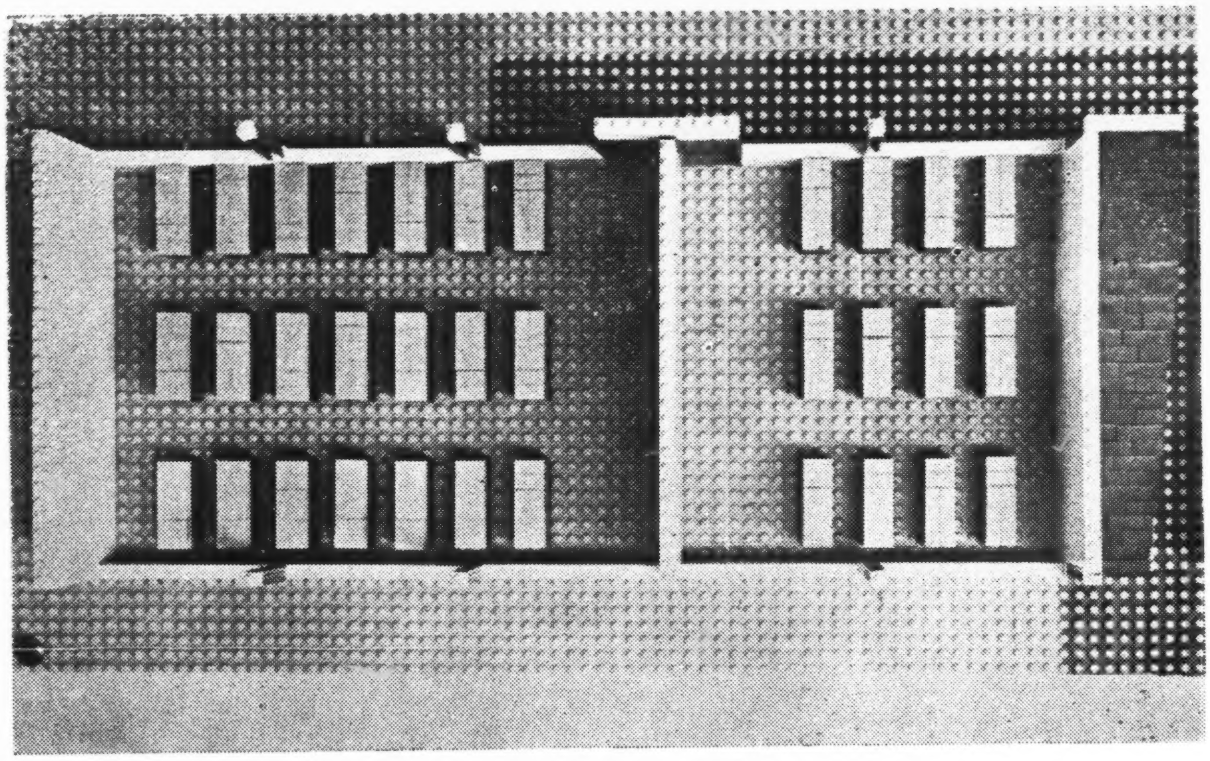


Plate 7 Plan view, ground floor, two-storey adjusted design, alternative A

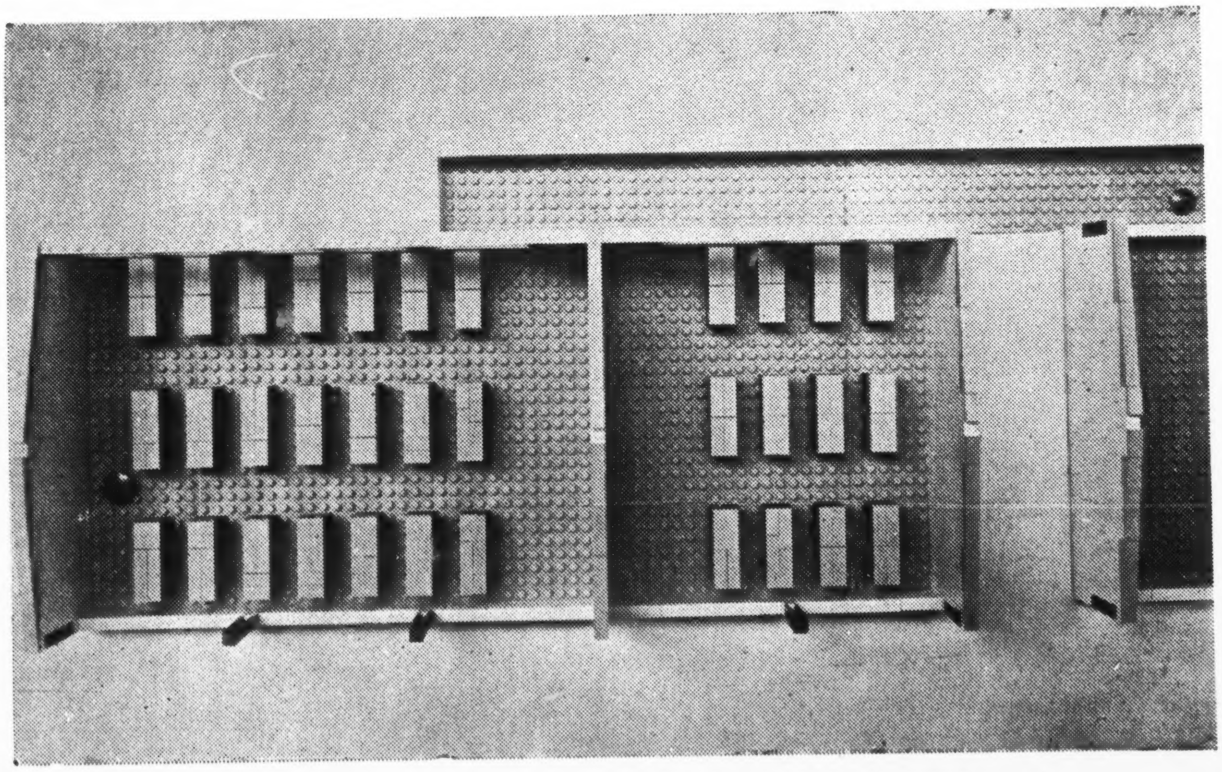


Plate 8 Plan view first floor, two-storey adjusted design, alternative A.

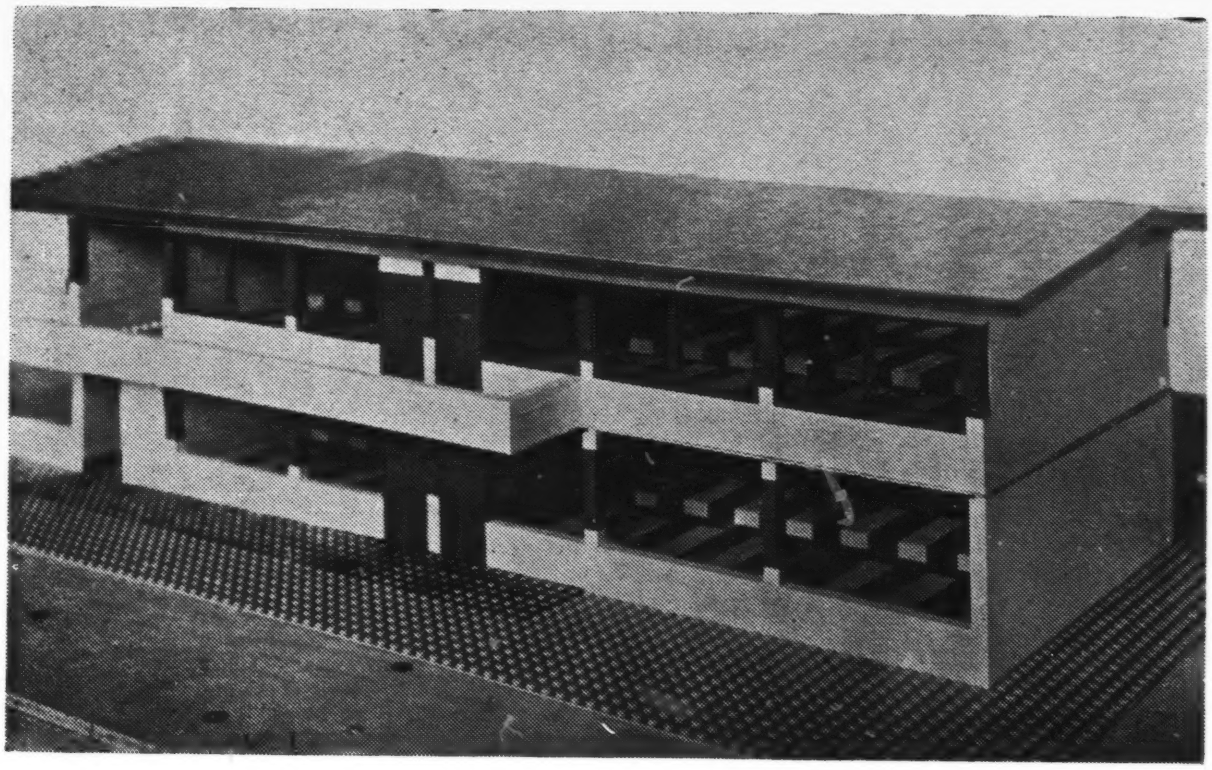


Plate 9

View of adjusted design A

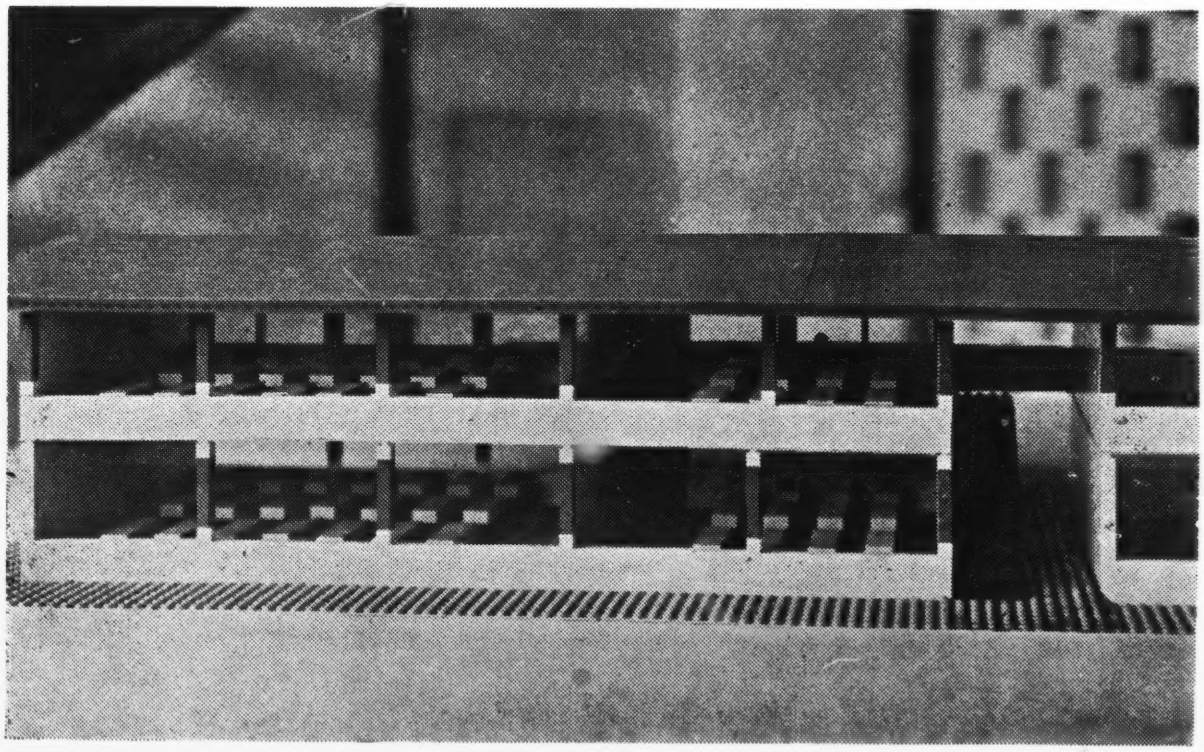


Plate 10

View of adjusted design A — other elevation

The existing standard plan will comfortably seat in the area given in Table VII a total of 96 secondary school students in four classes of 24 each. The adjusted plans, both alternative A & B, will seat 132 students in two classes of 24 each and two classes of 42 each (see seating arrangements in Figures 16 to 19 and Plates 7 & 8).

ii) Improvement of amenity

The existing plans do not provide for windows and full length doors and this, as has already been mentioned above, is a serious inconvenience. The adjusted plans allow for windows which act as sun screens, as well as for doors, thus greatly raising the amenity of teaching spaces. The savings in area and construction suggested enable the new plans to be built at a cost of Rs.9,000 less than the standard plans (per 4 classrooms) and this figure has been calculated using the Department's own cost data.

iii) Expansion

If more than 4 classrooms are required, then the unit can be repeated, joining on successive units as the need for classrooms arises. However, the unit has been costed to include a concrete frame and it would be possible for an extension upwards to three or four storeys to be built provided this was borne in mind during calculation of the frame sizes.

When a two-storey school is constructed in an urban area or units are added, especially where the cost of land is high, provision should be made in initial construction for the possible extension of the building vertically to several stories, even if such an expansion is not envisaged in the original plan.

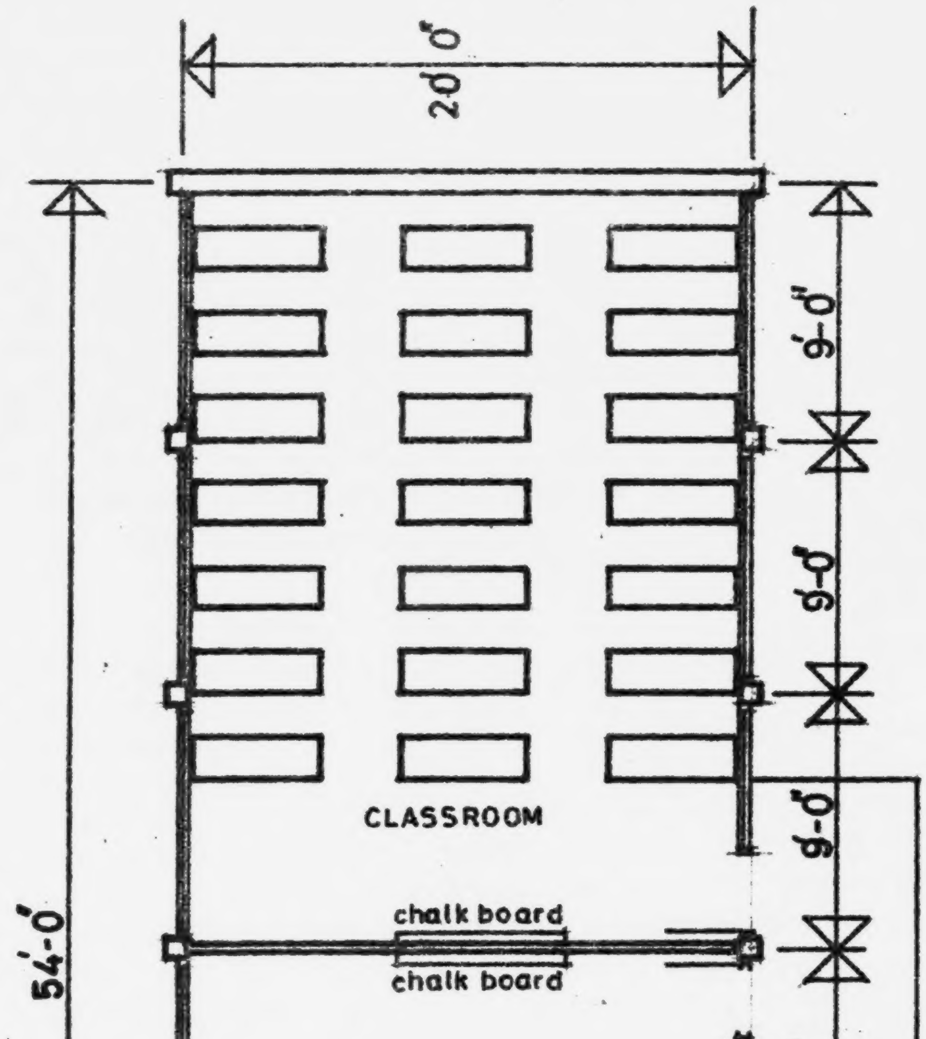
3.07 The need for new units

An overall look at Ceylon's schools suggests that they have been developed piece-meal, by adding new units to existing schools to meet the increasing year-by-year demands for more places.

This, when resources have carefully to be husbanded, is an inevitable, and indeed sensible, method of providing facilities for a rapidly growing school population. However, the danger is that in the clamour for more classrooms, laboratories and workshops, certain other essential elements of accommodation will be, if not altogether forgotten, at least relegated to a lower level in the list of building priorities.

Now that the quantum of new building required for Ceylon's schools is reducing (see Chapter 1) a higher proportion of the budget might not only be spent on maintenance (see Chapter 2) but also on improving the facilities for teaching staff and on health education through provision of better toilet facilities.

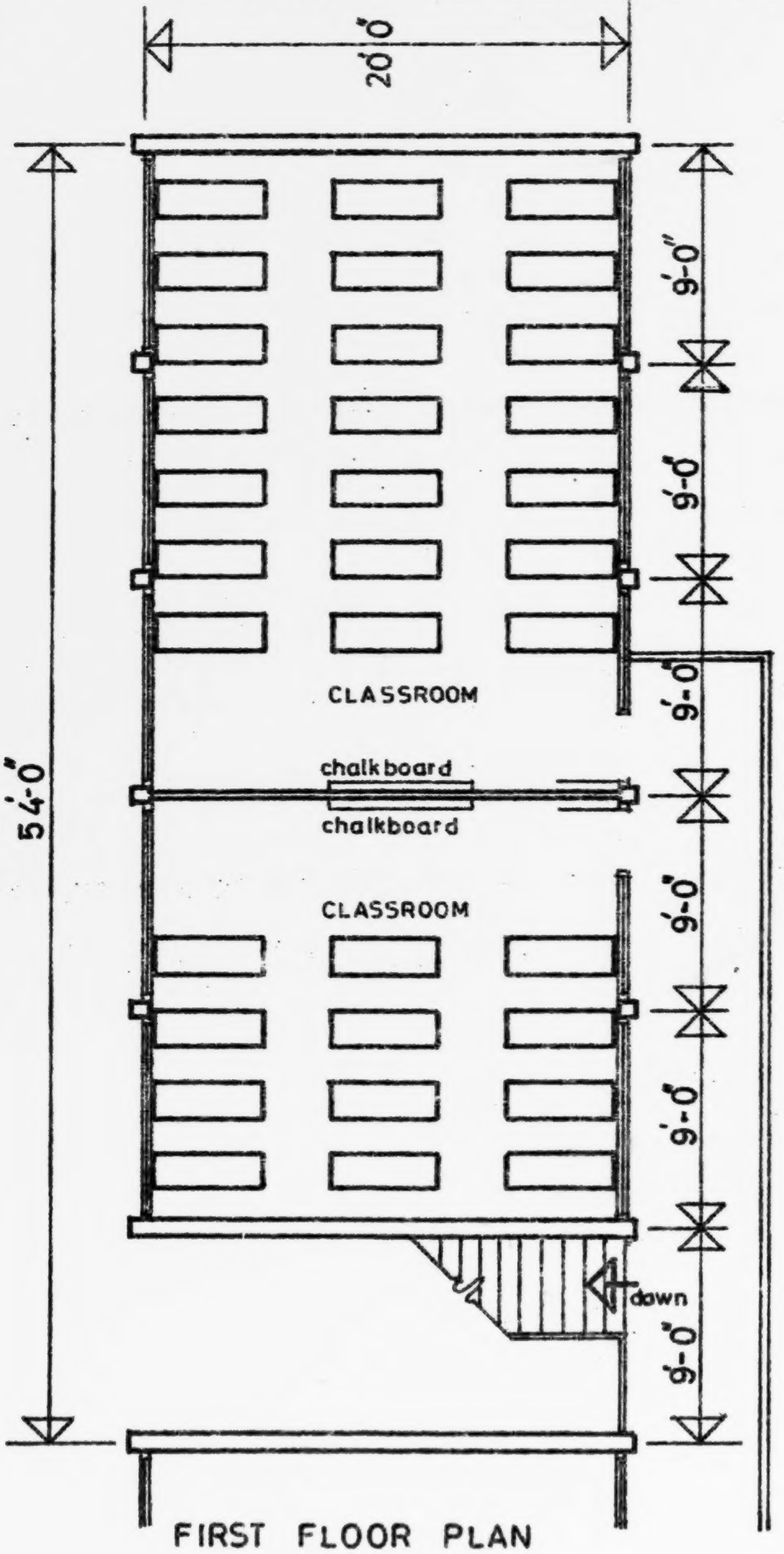
CEYLON SECONDARY GENERAL SCHOOLS
2 STORY CLASSROOM UNIT


20'0"
54'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
CLASSROOM
chalk board
chalk board
CLASSROOM

GROUND FLOOR PLAN
alternative A

FIGURE 16

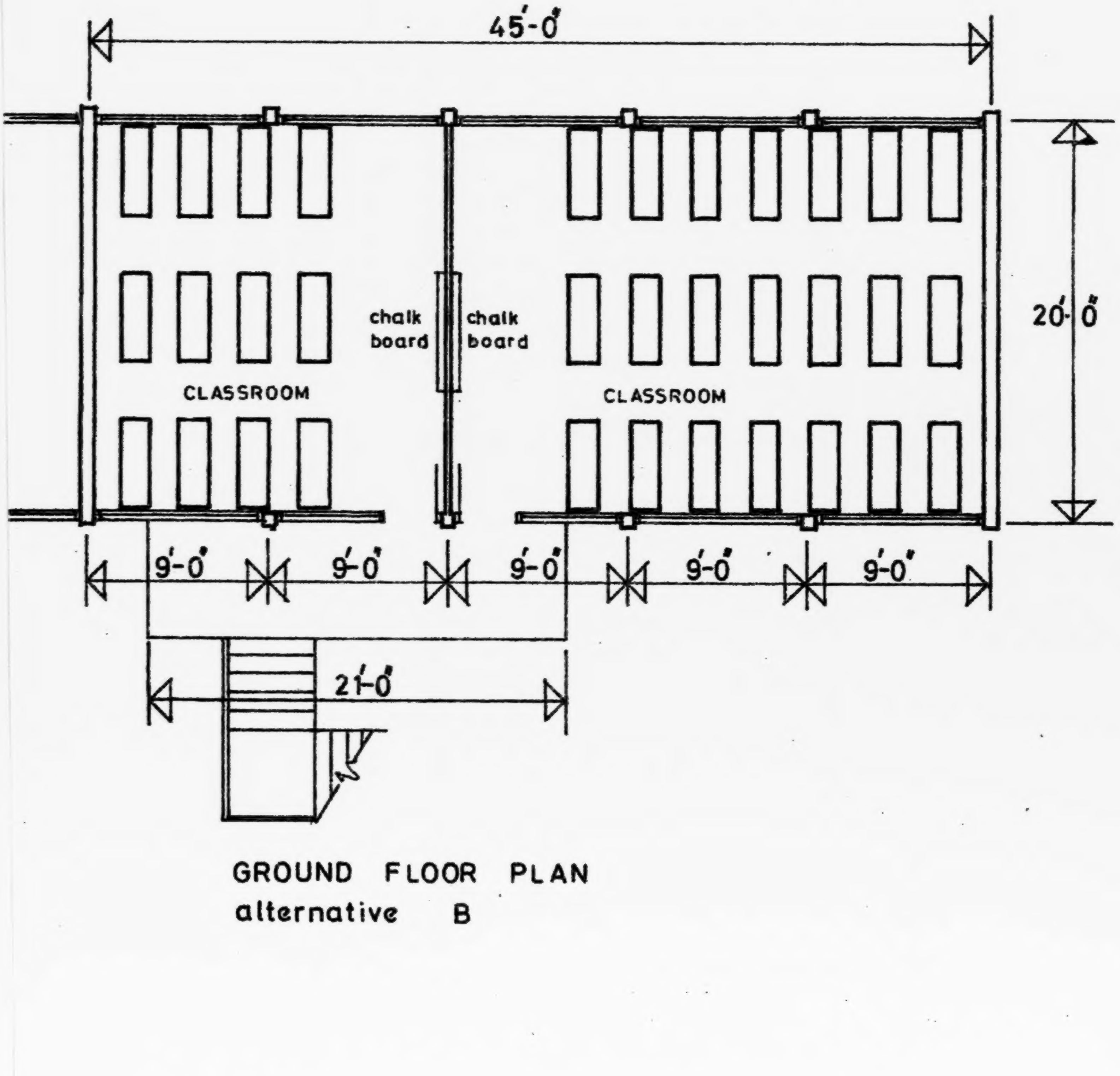
CEYLON SECONDARY GENERAL SCHOOLS
2 STOREY CLASSROOM UNIT


20'0"
54'0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
CLASSROOM
chalkboard
chalkboard
CLASSROOM
down

FIRST FLOOR PLAN
alternative A

FIGURE 17

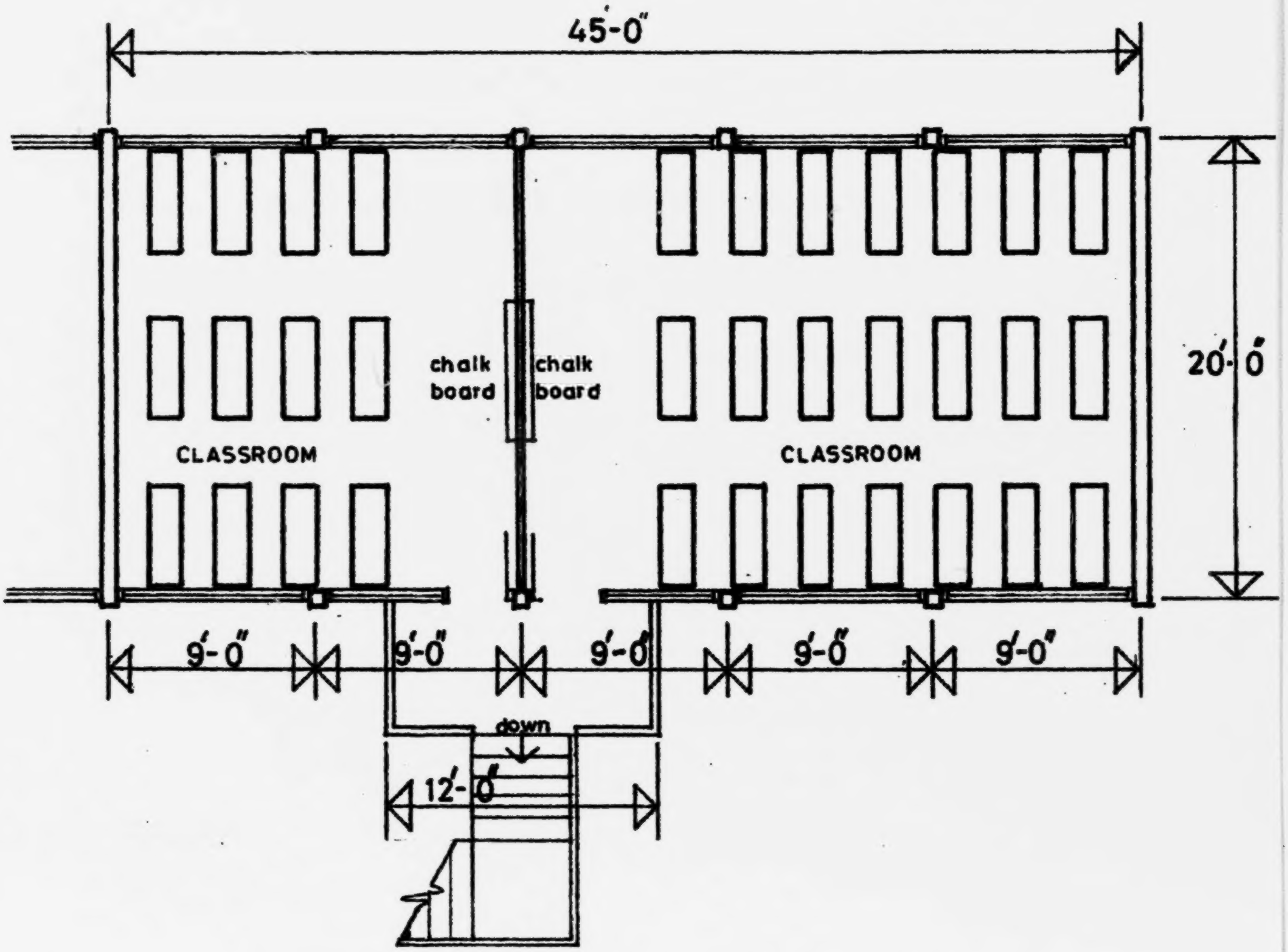
CEYLON SECONDARY GENERAL SCHOOLS
2 STOREY CLASSROOM UNIT


45'-0"
20'-0"
chalk board
chalk board
CLASSROOM
CLASSROOM
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
21'-0"

GROUND FLOOR PLAN
alternative B

FIGURE 18

CEYLON SECONDARY GENERAL SCHOOLS
2 STOREY CLASSROOM UNIT


45'-0"
20'-0"
chalk board
chalk board
CLASSROOM
CLASSROOM
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
down
12'-0"

FIRST FLOOR PLAN
alternative B

FIGURE 19

3.08 A new staff unit

At second-level, where students are being prepared for 'O' level examinations and for university entrance, the need for proper facilities for preparing lessons and marking work is very real. Ad-hoc staff rooms in spaces intended for storage, in stage dressing-rooms and classrooms, are not adequate. What is now needed is a "standard" plan for a small staff unit. This should be of 20'0" standard span so that it can be added readily to, or incorporated with, an existing standard unit - a classroom block.science laboratory or library.

CEYLON SECONDARY GENERAL SCHOOLS
NEW STANDARD STAFF UNIT

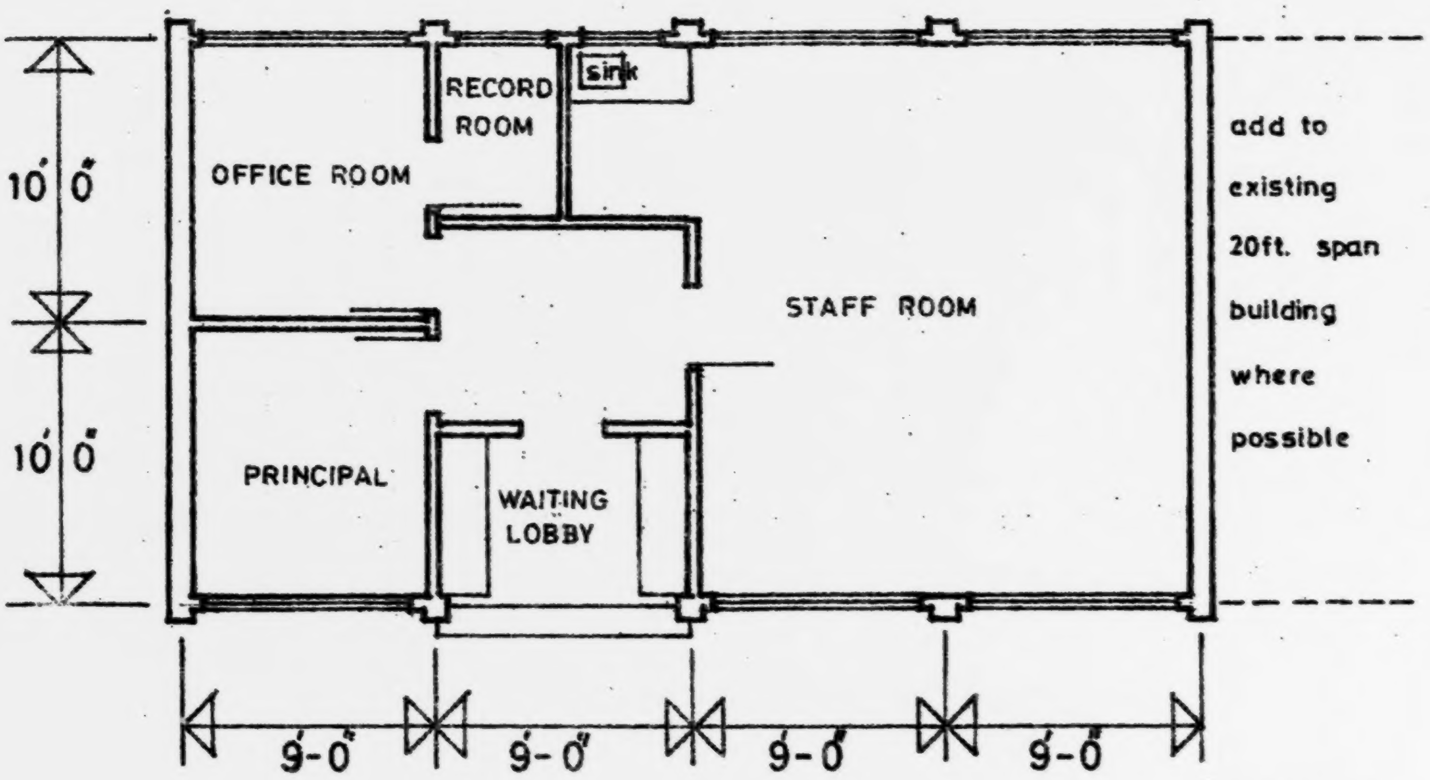

RECORD ROOM
sink
OFFICE ROOM
STAFF ROOM
PRINCIPAL
WAITING LOBBY
10'0"
10'0"
9-0"
9-0"
9-0"
9-0"
add to existing 20ft. span building where possible

FIGURE 20

3.09 New toilet unit

One of the most unsatisfactory aspects, from the view-point of cost and amenity, of many of the schools visited was the fragmentary nature of the toilet accommodation provided. Indeed, in most schools this was confined to a few quite separate single closets and occasionaly a urinal unit. No facilities for washing hands were available.

The cost of separate units of construction, whether they be teaching blocks or toilets is, as has been already mentioned, always greater than the cost of a combined unit. The cost of water services for such separate units is also formidable and leads more often than not, to failure to supply piped water.

There is thus a very strong case to be made for a standard plan for combined toilet accommodation - closets, urinals and hand-washing facilities for both sexes for a school of say 400 children. This can be extended for larger schools. Such a plan is shown in Figure 21.

In this connection (and the same may be said of science laboratories) it is surprising to see no use being made of rain water in Ceylon. To prevent contamination wells have to be dug at a considerable distance from the teaching or toilet unit where water is needed, and the children have to carry water in buckets. This means they carry the minimum possible and, for toilet use, often none at all. Yet, for some periods of the year there is heavy rainfall which could easily be collected in concrete or metal storage tanks adjacent to the place where water is required. Even a brick or stone tank, backed with puddled clay will hold water and would be inexpensive to construct. The many hilly sites on which schools are built lend themselves readily to collection of water in "cut and fill" tanks. Such tanks could well form Shramadana projects or projects built by assistance from Parent-Teacher Associations.

3.10 New Multi-purpose Unit

One of the observed trends in most of the secondary schools visited and referred to in Chapter 1 of this report was the tendency for larger teaching groups to be divided for optional subjects. The trend is more noticable at 'A' than at 'O' level but it exists and will develop.

If there are to be teaching groups of as few as 5, 10 or 15 students, then space will be wasted if they occupy rooms designed for larger teaching groups; but when extensions are required to existing accommodation purely as a result of this tendency to divide up classes into elective subjects-groups, then at present, then the only current recourse is to standard plans for buildings incorporating large teaching spaces. What is now needed is a standard plan incorporating a series of smaller cells to meet the new needs. This building might include one or two larger rooms, or a science unit, library or home economics unit; it could with ease contain the staff accommodation mentioned above.

Suggestions for such a building is outlined in figures 22 & 23.

CEYLON SECONDARY GENERAL SCHOOLS
NEW STANDARD TOILET

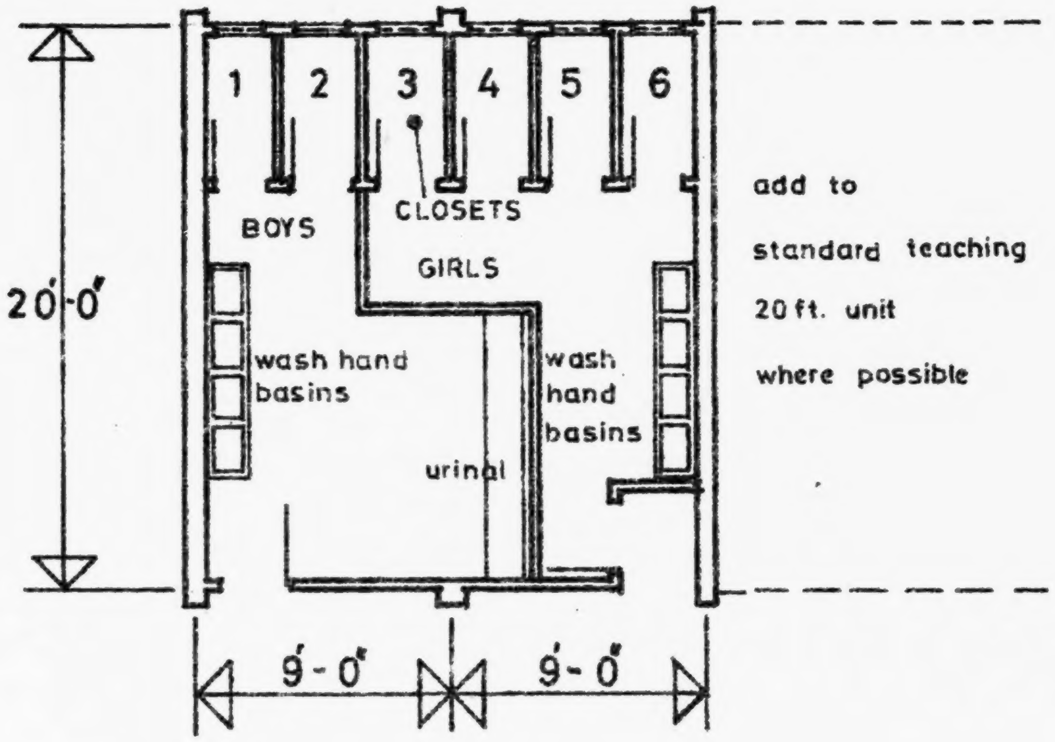

1
2
3
4
5
6
CLOSETS
BOYS
GIRLS
wash hand basins
wash hand basins
urinal
20'-0"
9'-0"
9'-0"
add to standard teaching 20 ft. unit where possible

FIGURE 21

CEYLON SECONDARY GENERAL SCHOOLS
NEW MULTIPURPOSE UNIT
SOME ALTERNATIVES

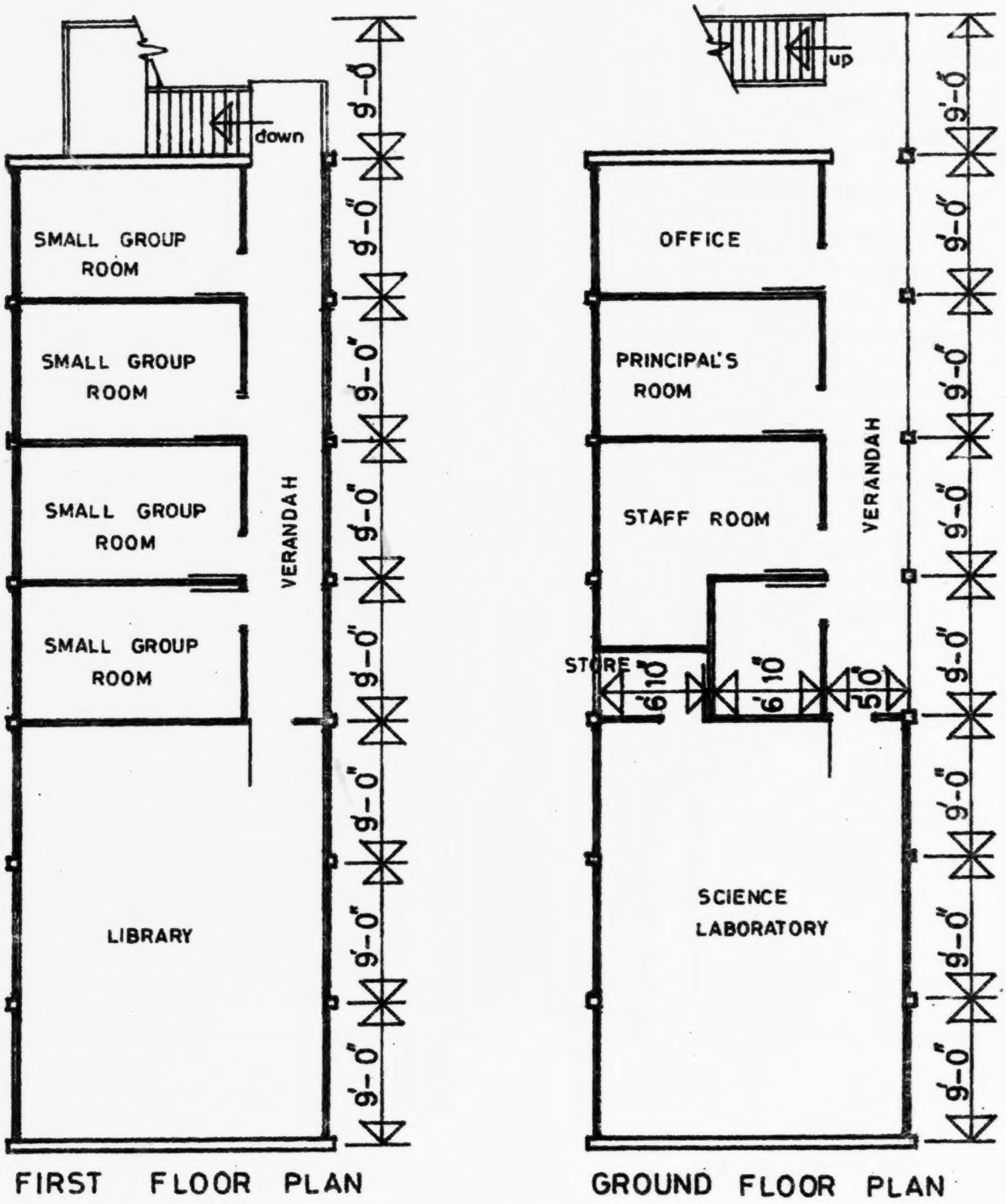
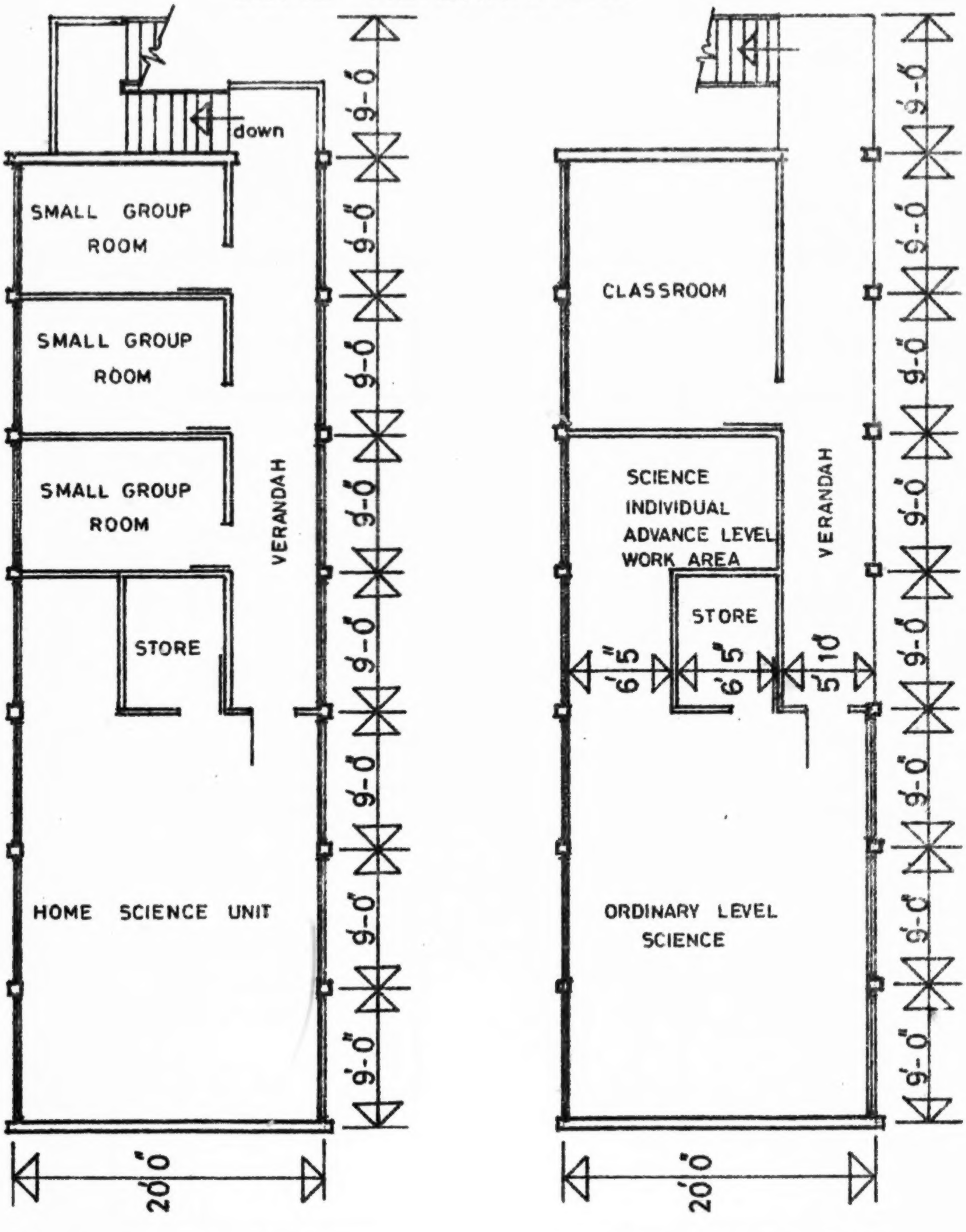

down
SMALL GROUP ROOM
SMALL GROUP ROOM
SMALL GROUP ROOM
SMALL GROUP ROOM
LIBRARY
VERANDAH
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
FIRST FLOOR PLAN
up
OFFICE
PRINCIPAL'S ROOM
STAFF ROOM
STORE
6'10"
6'10"
5'0"
SCIENCE LABORATORY
VERANDAH
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
9'-0"
GROUND FLOOR PLAN

FIGURE 22

CEYLON SECONDARY GENERAL SCHOOLS
NEW MULTIPURPOSE UNIT
SOME ALTERNATIVES


down
SMALL GROUP ROOM
SMALL GROUP ROOM
SMALL GROUP ROOM
STORE
VERANDAH
HOME SCIENCE UNIT
9'-0"
20'0"
CLASSROOM
SCIENCE INDIVIDUAL ADVANCE LEVEL WORK AREA
STORE
VERANDAH
ORDINARY LEVEL SCIENCE
6'5"
6'5"
5'10"
9'-0"
20'0"

FIRST FLOOR PLAN GROUND FLOOR PLAN

FIGURE 23

Annexure I

CALCULATION OF TEACHING SPACE REQUIREMENTS IN RELATION TO THE CURRICULUM FOR A SECONDARY GENERAL SCHOOL OF 560 PUPILS

Attached Chart I gives an analysis of the space utilization of secondary school with four grades, Grades IX, X, XI and XII. It is a type of comprehensive secondary general school with a very broad curriculum, enabling the children to follow courses in arts, science, agriculture, crafts, commerce and home science. As the groups studying commerce, crafts or home science would necessarily be small in proportion to total enrolment, separate classes are not formed for them. There is a combination of classes, cutting across class units, and reorganization of groups, where necessary, to bring about economy of space and teaching staff.

The school is situated in a rural area where there are no other secondary educational institutions so that although the numbers are small, a broad curriculum has to be provided. The children come to school from a radius of about six miles and are drawn from a number of primary schools in districts which form one second-level education zone. The school gives preference in admission to the children of the zone. Vacancies which remain after all the children of the zone are admitted, are offered to children of other zones.

According to the population projection of the zone, and the projected number of children in Grade VIII who are likely to seek admission to this general secondary school, it was estimated at the time of its establishment that a school whose design capacity would be about 560 pupils (16 classes with a average enrolment of 35 in each) would meet the requirements of the zone for about 10 years.

The school opened with 150 children in Grades IX and X (admission to Grade X from other zones). The buildings calculated to be necessary for the first 3 years were built before the school opened and the other buildings were ready in due course.

Chart I shows the increase in enrolment, broadening of curriculum and corresponding provision of building. It will be seen from this chart that in 10 years the school has already reached the maximum design accommodation and that some classes are really overcrowded. Additional buildings for general teaching spaces can be provided to the extent that the special rooms and laboratories are fully used. In the analysis in Chart I it is assumed that all the teaching of science is done in the laboratories. By using the laboratories only for practical work and providing the necessary ordinary teaching spaces for theory lessons, it may be possible to increase the number of science classes. For instance, if each of the classes in Grades IX and X is to have 3 periods, and each of the classes in Grades XI and XII is to have 5 periods of practical work in the science subjects, it would be possible to accommodate these classes in the laboratories. In addition, it will be possible to allot 18 periods of practical work in chemistry and biology to the 3 agricultural science classes in the IX and X grades. The total number of periods per week will then work out at 150. The agricultural group can easibly be expanded to an agricultural class.

From the same chart it will be seen that the Commerce Room is put to almost 100% use because all the four Commerce subjects are taught in the Commerce Room. It may be possible to expand the IX and X Grade Commerce groups into full classes and also to extend the teaching of Commerce to XI and XII Grades by using the Commerce Room only for typing and some shorthand periods. The groups of children studying crafts can also be expanded to full classes.

The Home Science Room is now used only for 18 periods for the work for which it is primarily intended. By constructing a separate Music Room (so that there is no need to teach Music in the Home Science Room) and the requisite number of general teaching spaces, it would be possible to have three IX and X Grade classes and three XI and XII Grade classes in Home Science.

It can now be seen that when the maximum use is made of the special rooms the school could have the following classes:-

	Grades			
	IX	X	XI	XII
Art	2	3	1	2
Crafts	1	2	-	-
Home Science	1	2	1	2
Commerce	1	2	1	2
Agr.Science	1	2	-	-
Science	3	5	1	2
	9	16	4	8

Assuming that the enrolment can be sent out as follows,

COURSES	PUPILS PER §CLASS IN EACH GRADE			
	IX	X	XI	XII
Arts	35	35	30	30
Crafts	30	30	-	-
Home Science	30	30	20	20
Commerce	30	30	20	20
Agr.Science	30	30	-	-
Science	30	30	20	20

§ (For number of classes in each Grade, see Chart III of the Annexure)

then the school will have about 1,045 children on the roll. 1,000 is a reasonable number of pupils for a school with Grades IX, X, XI and XII only. If further needs for accommodation arises, it is advisable to start a new school.

The additional teaching spaces required for the expansion of the school when it is to have 37 classes with about 1,000 children can be found out by analysing the curriculum against the grades and classes as done in Chart I. This is in fact worked out in the attached Chart II. This analysis shows that for increasing the enrolment from about 550 to about 1,000 and the number of classes from 16 - 36, the additional space that has to be provided would be 10 large teaching spaces, 9 small teaching spaces, one music room and one assembly hall. The assembly hall which was optional at the time the school was designed for 560 is a 'must' now as the existing reading rooms, common rooms and laboratories would not be sufficient for the expected large enrolment for their group work, study purposes, seminars, meetings and also for individual work during their off-periods.

The above analyses of a school in Charts I to III shows:-

(a) A method of calculating the necessary space for a given type of school with a given curriculum on the basis of intensive use of the buildings.

(b) That if the buildings are suitably designed and intensively used the usual number of standard classrooms can be reduced with no adverse effect on the educational programme.

(c) How a full plan, drawn according to the projected needs of an area, can be executed in stages.

(d) How a building programme for a new second-level school or a second-level section of an existing school, can commence with the provision of the special teaching areas, which in a secondary school have to be given priority. Work done in the usual type of classroom by lecture or "talk-and-chalk" method can be carried on in almost any kind of space, even in open air. However, the work that involves experimentation, observation and creative activity can be done satisfactorily only in the special spaces provided, with the necessary apparatus, tools or aids.

CALCULATION OF TEACHING SPACE REQUIREMENTS IN RELATION TO THE CURRICULU

SCHOOL OF 560 PUPILS

SUBJECT	9				10						11		12						
	Arts, Crafts, Commerce, Home Science A	B	Science Agri-culture A	B	Arts Crafts Commerce Home Science A	B	C	Science Agri-Culture A	B	C	Arts	Science	Arts A	B	Science A	B	Total No. of Periods		Total Teaching Space Requireme Various Streams
I. Required																			
Ist Language	5	5	5	5	5	5	5	5	5	5	6	–	6	6	–	–	68		
2nd Language	5	5	5	5	5	5	5	5	5	5	7	7	7	7	7	7	92		
Mathematics	– 6 –		6	6	– 6 –		6	6	6	6	–	–	–	–	–	–	48		8 large classroom spaces
Arithmetic	– 6 –		–	–	– 6 –		6	–	–	–	–	–	–	–	–	–	18		
Com. Arithmetic	– 6 –		–	–	– 6 –		6	–	–	–	–	–	–	–	–	–	18		
Religion	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	1	26	270	
Agriculture	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	32	32	Agricultural plots
P. T.	1	1	1	1	1	1	1	1	1	1	–	–	–	–	–	–	10	10	Playground – open, roofed area fo
II. Elective-for Arts, Science, Home Science and Commerce																			
History	– 4 –		–	–	– 4 –		*4	–	–	–	6	–	6	6	–	–	30		
Commerce	– 4 –		–	–	– 4 –		*4	–	–	–	–	–	–	–	–	–	12		Commerce room
Buddhist Civilisation	–	–	–	–	–	–	–	–	–	–	6*	–	6*	6*	–	–	18		
Geography	– 3 –		–	–	– 3 –		3	–	–	–	6	–	6	6	–	–	27		Geography room – 27 periods (
Hygiene	– 3 –		–	–	– 3 –		*3	–	–	–	–	–	–	–	–	–	9		9 periods (
Accounts	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		
Pali	– 3 –		–	–	– 3 –		*3	–	–	–	6*	–	6*	6*	–	–	27		
Government	– 3 –		–	–	– 3 –		*3	–	–	–	6*	–	6*	6*	–	–	27		
Literature	– 3 –		–	–	– 3 –		*3	–	–	–	–	–	–	–	–	–	9		Home Science
Needle Work	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		Music } combined room
Economics	– 3 –		–	–	– 3 –		*3	–	–	–	6	–	6	6	–	–	27		Needlework
Typing	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		Arts and Crafts
Home Science	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		
Wood-work	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		1 large multi-purpose room for gr
Crafts	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		1 large teaching area
Art	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		
Short-hand	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		2 small teaching areas
Music	– 3 –		–	–	– 3 –		3	–	–	–	–	–	–	–	–	–	9		1 open paved area 67 periods (
																		267	9 periods (
III. Elective-for Science and Agriculture																			
Geography	–	–	– 3 –		–	–	–	–3–		3	–	–	–	–	–	–	9		
Literature	–	–	– 3 –		–	–	–	–3–		3*	–	–	–	–	–	–	9		
Physics	–	–	5	5	–	–	–	5	5	5	–	7	–	–	7	7	46		1 Physics lab.
Agriculture	–	–	–	5	–	–	–	–	5	5	–	–	–	–	–	–	15		1 Agricultural lab.
Chemistry	–	–	5	5	–	–	–	5	5	5	–	7	–	–	7	7	46		1 Chemistry lab.
Biology	–	–	6	6	–	–	–	6	6	6	–	–	–	–	–	–	30		1 Biology lab.
Zoology	–	–	–	–	–	–	–	–	–	–	–	7	–	–	7	7	21		1 General Lab. /demonstration/
Adv. Maths	–	–	–	–	–	–	–	–	–	–	–	*7	–	–	7*	7*	21		lecture lab.
Botany	–	–	–	–	–	–	–	–	–	–	–	7	–	–	7	7	21		1 small teaching area
App. Maths	–	–	–	–	–	–	–	–	–	–	–	*7	–	–	7*	7*	21		
																		239	
TOTAL																	818	818	

§ These spaces can be provided in a room-less building which can be provided with removal partitions and furniture.

§§ Some of these spaces too can be used for guided teaching purposes, when time-tables arrangements demand their use.

§§§ Where this is provided, the 3 small teaching areas and the open roofed areas need not be provided. The large common room, 9 large teaching spaces, 4 laboratories, the geography room and the reading room can serve as the 16 form or base rooms.

* Indicates, half a class or a small group for classroom work.

Science classes (11 & 12) have 2 periods free work each., one not included in the above analysis to be spent in the labs. or library or Reading room.

No. of classes

Average enrolme each class

Design capacity

No. of periods pe

ANNEXURE I
CHART 1

RRICULUM FOR A SECONDARY GENERAL
PUPILS

pace Requirements For s Streams	No. of periods	Total Overall Space Requirements	No. of periods
spaces	270		
	32		
roofed area for shelter	10		
	39	1 large room for group teaching 9 large teaching apaces (about 400 sq. ft. each) 3 small teaching areas (about 200 sq. ft. each) 1 Geography room 1 Commerce room 1 Home Sc., Music 1 Crafts, Art 1 Agr. garden	270 (I.) 80 (II.) 350 76 (II.) 42 (III.) 118 36 39 27 27 32
27 periods (II.) 9 periods (III.)	36		
ombined room	27		
	27		
se room for group work. ea	80		
eas 67 periods (II.) 9 periods (III.)	76		
		§§§ Assembly Hall 1 Agricultural lab. 1 Physics lab. 1 Chemistry lab. 1 Biology lab. 1 General lab. /demonstration/ lecture lab.	179
monstration/ ea	164 42	§§(open paved areas 1 (open roofed area 1 (Reading room/study 1 (Library 1 (Playground 1 Staff common room Admn. Office 1	10
	818		818

o. of classes	16
verage enrolment in each class	35
esign capacity	560
o. of periods per week	40

ANNEXURE I
CHART II

ENROLMENT OVER FIRST 10 YEARS AND RELATED ACCOMMODATION REQUIREMENTS

Years	IX				X						XI		XII				*Total Class*	*Total enrolment*	*Accommodation*
	Art.Com.etc.		*Science*		*Art.Com.etc.*			*Science*			*Art*	*Sc.*	*A r t*		*Science*				
	A	*B*	*A*	*B*	*A*	*B*	*C*	*A*	*B*	*C*			*A*	*B*	*A*	*B*			.
1 Yr.	30	30	-	-	30	30	30	(from other zones)					-	-	-	-	5	150	Adm.section Library and Reading room, Geog. room, 2 large teaching areas 2 small teaching areas Commerce room, Music, Art room & open dancing area, toilets, open roofed area, 1 multi-purpose room
2 Yr.	30	30	-	-	30	30	40	-	-	-	20	-	-	-	-	-	6	180	
3 Yr.	35	30	-	-	35	30	40	-	-	-	25	-	20	-	-	-	7	215	
4 Yr	30	30	30	-	30	30	40	-	-	-	20	-	25	-	-	-	8	300	Gen.Sc.Lab. Sc.xm.Agri. Science unit 3 large teaching spaces
5 Yr	35	30	30	-	30	30	40.	30	-	-	20	-	25	-	-	-	9		
6 Yr	30	30	30	-	35	30	40	30	20	-	20	-	35	-	-	-	10		
7 Yr	35	35	30	30	30	30	40	30	20	-	25	-	25	20	-	-	12	405	4 large teaching areas 1 small teaching area
8 Yr	35	35	35	30	35	35	40	30	30	25	30	-	25	20	-	-	13		
9 Yr	35	40	35	30	35	35	40	35	30	30	30	20	30	20	10	-	14	500	Chemistry, Physics, Biology Labs.
10 Yr	40	40	35	35	35	40	40	35	30	30	30	25	35	20	20	10	16		

Enrolment during the first 10 years and the related accommodation requirements.

SPACE REQUIREMENTS FOR DEVELOPED SECOND LEVEL GENERAL S

Subjects	9 10 No. of classes	Periods per week	Space periods	11 12 No. of classes	Periods per week	Space periods	Total space periods	No. of spaces	Requirement for streams
Arts: Compulsories vide Chart 1	5	18	90	3	14	42	132		
Electives: P. T. & Agriculture	5	3	15	3	2	6	21	1	Garden
History	5	4	20	2	6	18	38	1	Open roofed area
Buddhist Civilisation	—	—	—	3	6	18	18	2	Geography room
Geography	5	4	20	3	6	18	38	6	Small teaching areas
Government	5	3	15	3	6	18	33	1	Large teaching areas
Art	5	3	15	—	—	—	15	1	Open paved area
Pali	—	—	—	3	6	18	—		Music room
Literature	5	4	20	—	—	—	20		
Economics	5	4	20	3	6	18	38		
Pali	5	4	20	—	—	—	20		
Music	5	4	20	—	—	—	20 411		Total
Commerce: Compulsories vide Chart 1	3	18	54	3	14	42	96		
Electives: P. T. & Agriculture	3	3	9	3	2	6	15		
Typing	3	4	12	3	6	18	30	1	Garden
Short-hand	3	4	12	3	6	18	30	1	Commerce room
Commerce	3	3	9	—	—	—	9	4	Small teaching areas
Accountancy	3	3	12	3	6	18	30		Large teaching areas
Economics	3	3	12	3	6	18	30 240		Total
Arts-Crafts: Compulsories vide Chart 1	3	18	54	—	—	—	54		
Electives: P. T. & Agriculture	3	3	9	—	—	—	9	1	Garden
Geometrical Drawing	3	4	12	—	—	—	12 }	1	Wood-work shop
Wood-work	3	4	12	—	—	—	12 }	1	Arts-craft room
Crafts	3	4	12	—	—	—	12	2	Large teaching areas
Art	3	4	12	—	—	—	12		
Literature	3	4	12	—	—	—	12		
Government	3	4	12	—	—	—	12 135		Total
Home Science: Compulsories vide Chart 1	3	18	54	3	8	24	78		
Electives: P. T. & Agriculture	3	3	9	3	2	6	15		
Hygiene	3	3	9	—	—	—	9	2	Garden
Literature	3	4	12	—	—	—	12	2	Small teaching areas
Home Science	3	4	12	3	23	69	81	1	Large teaching areas
Needle Work	3	4	12	3	7	21	33		Double unit Home science r
Music	3	4	12	—	—	—	12		
							240		Total
Agriculture: Complusories vide Chart 1	3	18	54	—	—	—	54		
Electives: P. T. & Agriculture	3	3	9	—	—	—	9		
Literature	3	3	9	—	—	—	9	6	Garden
Geography	3	3	9	—	—	—	9	1	Large teaching
Chemistry	3	5	15	—	—	—	15	2	Agricultural lab.
Biology	3	6	18	—	—	—	18		Small teaching areas
Agriculture	3	5	15	—	—	—	15 129		Total
Science: Compulsories vide Chart I	8	18	144	3	8	24	168		
Electives: Free work, P. T. & Agriculture	8	3	24	3	4	12	36		
Literature	8	3	24	—	—	—	24	1	Garden
Geography	8	3	24	—	—	—	24	1	Physics lab.
Physics	8	5	40	3	7	21	61	1	Chemistry lab.
Chemistry	8	5	40	3	7	21	61	1	Chemistry lab.
Biology	8	6	48	—	—	—	48	5	Biology lab.
Botany	—	—	—	3	7	21	21	1	General lab.
Applied Maths	—	—	—	3	7	21	21		Small teaching areas
Zoology	—	—	—	3	7	21	21		Open paved area
Advance Maths	—	—	—	3	7	21	21 506		Total
							1661		GRAND TO

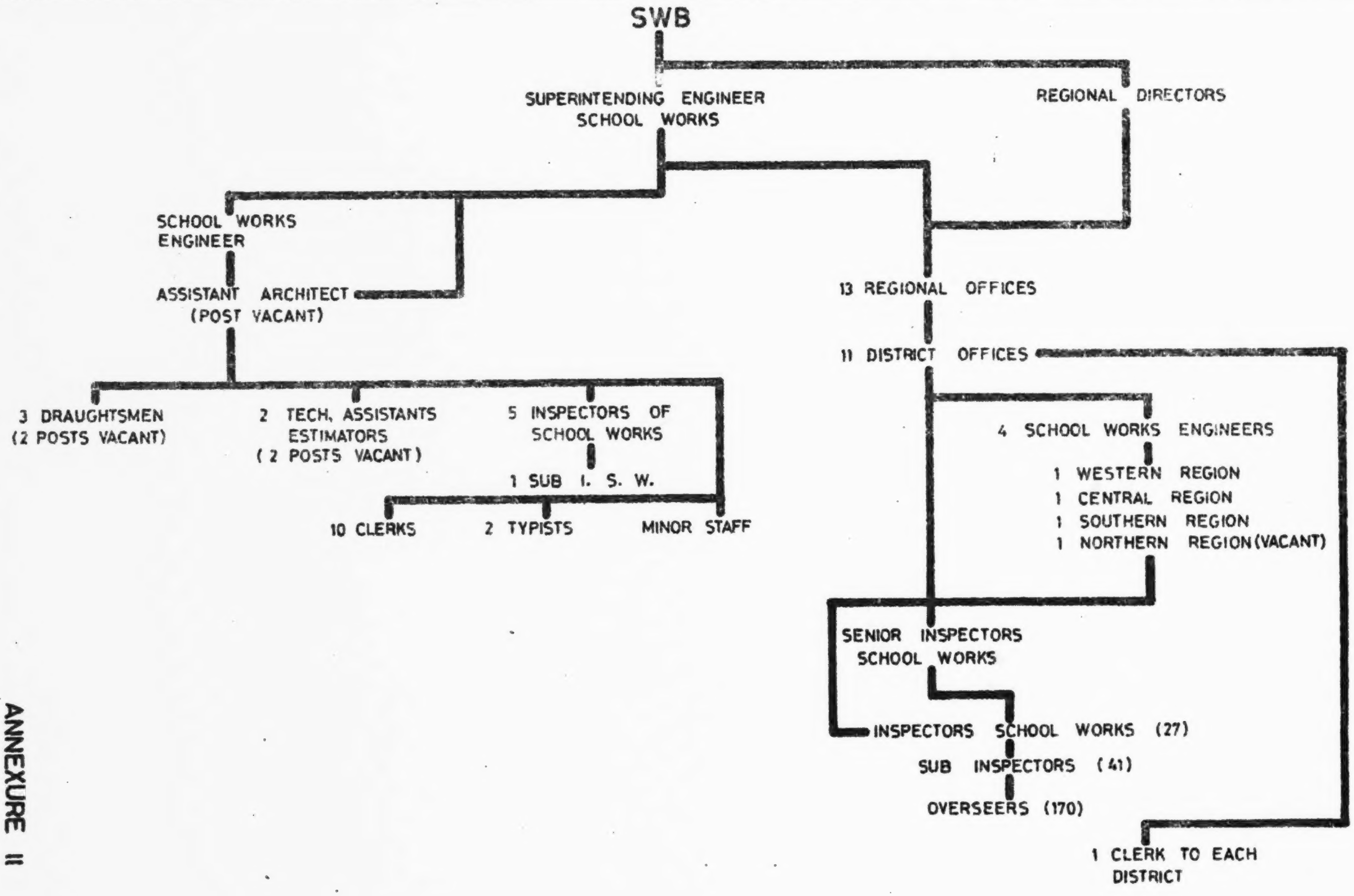
ANNEXURE I
CHART III

AL SCHOOL FOR 1000 PUPILS

streams	Space periods	No. of spaces	Overall requirements	Space periods
	21			
	38			
	90			
	227			
	32			
		1	Play ground	
		1	Open roofed area	31
Total 408				
		1	Geography room	38
		12	Small teaching spaces	425
	15	1	Large multi-purpose Commerce room	725
	36	19	Large teaching spaces	
	36	1	Music room	32
	153	1	Commerce room	36
		1	Wood-work shop	24
Total 240		1	Art-craft room	39
		1	Double unit Home science room	72
	9	1	Agricultural laboratory	15
	24	1	Agricultural area	74
	39	1	Physics lab.	
	78	1	Chemistry lab.	150
		1	Biology lab.	
		1	General lab.	
Total 150				
		2	Open paved areas	
		1	Library	
	15	1	Reading room/study	
	72	1	Assembly hall	
	69	1	Administrative section consisting of:	
science room	72		Principal's office	
			General office, Record room	
Total 228			Store	
			Visitors or waiting room	
	9	2	Small rooms	
	198	1	Staff Common room	
	15			
	66			
Total 288				
	36			
	150			
	161			
Total 347				
RAND TOTAL	1661			1661

ANNEXURE II

ORGANISATIONAL CHART - SCHOOL WORKS BRANCH MINISTRY OF EDUCATION AND CULTURAL AFFAIRS


SWB
SUPERINTENDING ENGINEER SCHOOL WORKS
REGIONAL DIRECTORS
SCHOOL WORKS ENGINEER
ASSISTANT ARCHITECT (POST VACANT)
3 DRAUGHTSMEN (2 POSTS VACANT)
2 TECH. ASSISTANTS ESTIMATORS (2 POSTS VACANT)
5 INSPECTORS OF SCHOOL WORKS
1 SUB I. S. W.
10 CLERKS
2 TYPISTS
MINOR STAFF
13 REGIONAL OFFICES
11 DISTRICT OFFICES
4 SCHOOL WORKS ENGINEERS
1 WESTERN REGION
1 CENTRAL REGION
1 SOUTHERN REGION
1 NORTHERN REGION (VACANT)
SENIOR INSPECTORS SCHOOL WORKS
INSPECTORS SCHOOL WORKS (27)
SUB INSPECTORS (41)
OVERSEERS (170)
1 CLERK TO EACH DISTRICT

ANNEXURE III

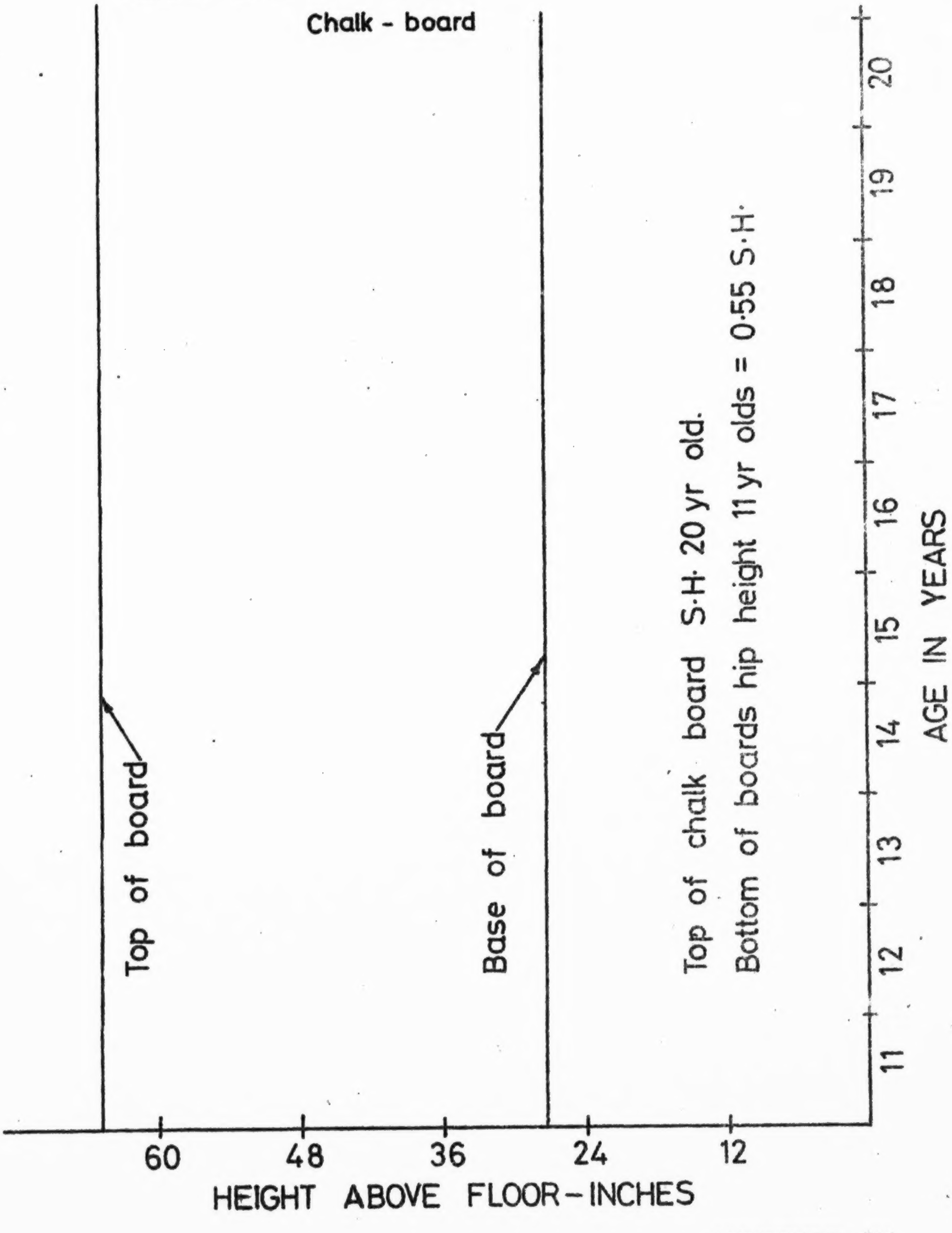
AGE	S.H. INCHES	STANDING EYE LEVEL	SITTING EYE LEVEL	SEAT HEIGHT	SEAT BREADTH	SEAT DEPTH	DESK TOP HEIGHT	SHOULDER WIDTH	WRITING SURFACE	TOP OF CHALK BOARD	BOTTOM OF CHALK BOARD
		S.H.x 0.94	S.H.x 0.72	S.H.x 0.25	S.H.x 0.25 + 0.4ins	S.H.x 0.22 - 0.4ins	S.H.x 0.315+ 3.2ins	S.H.x 0.26	S.H.x 0.30x 0.38	S.H.	S.H. x 0.55
11	50	47.0	36	12.5	12.9	10.6	18.9	13	15x19	50	27.5
12	52	48.9	37.4	13	13.4	11	19.6	13.5	15.6x 19.8	52	28.6
13	54	50.8	38.9	13.5	13.9	11.5	20.2	14	16.2x 20.5	54	29.7
14	56	52.6	40.3	14	14.4	11.9	20.8	14.6	16.8x 21.3	56	30.8
15	58	54.5	41.8	14.5	14.9	12.4	21.5	15.1	17.4x 22	58	31.9
16	60	56.4	43.2	15	15.4	12.8	22.1	15.6	18 x 22.8	60	33
17	61	57.3	43.9	15.3	15.7	13	22.4	15.9	18.3x 23.2	61	33.6
18	62	58.3	44.6	15.5	15.9	13.2	22.7	16.1	18.6x 23.6	62	34.1
19	64	60.2	46.1	16	16.4	13.7	23.4	16.6	19.2x 24.3	64	35.2
20	65	61.1	46.8	16.3	16.7	13.9	23.7	16.9	19.5x 24.7	65	35.8

S.H. = Standing Height
General data in inches

BODY SIZES, CEYLON SECONDARY GENERAL SCHOOLS

BODY SIZES

HEIGHT OF — Pin - board
Chalk - board

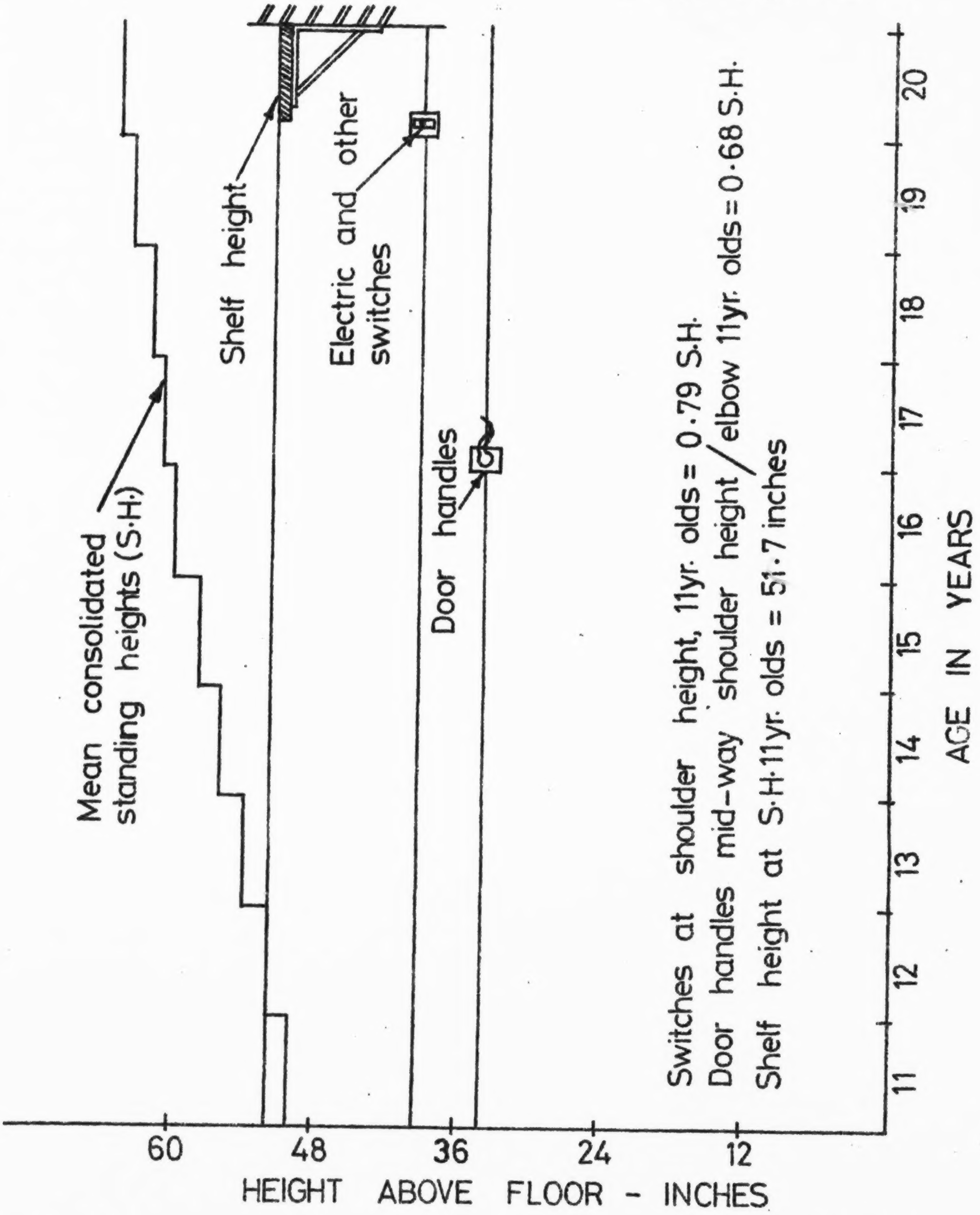


ANNEXURE III

BODY SIZES

HEIGHT OF - Light switches
Door handles
Top shelves

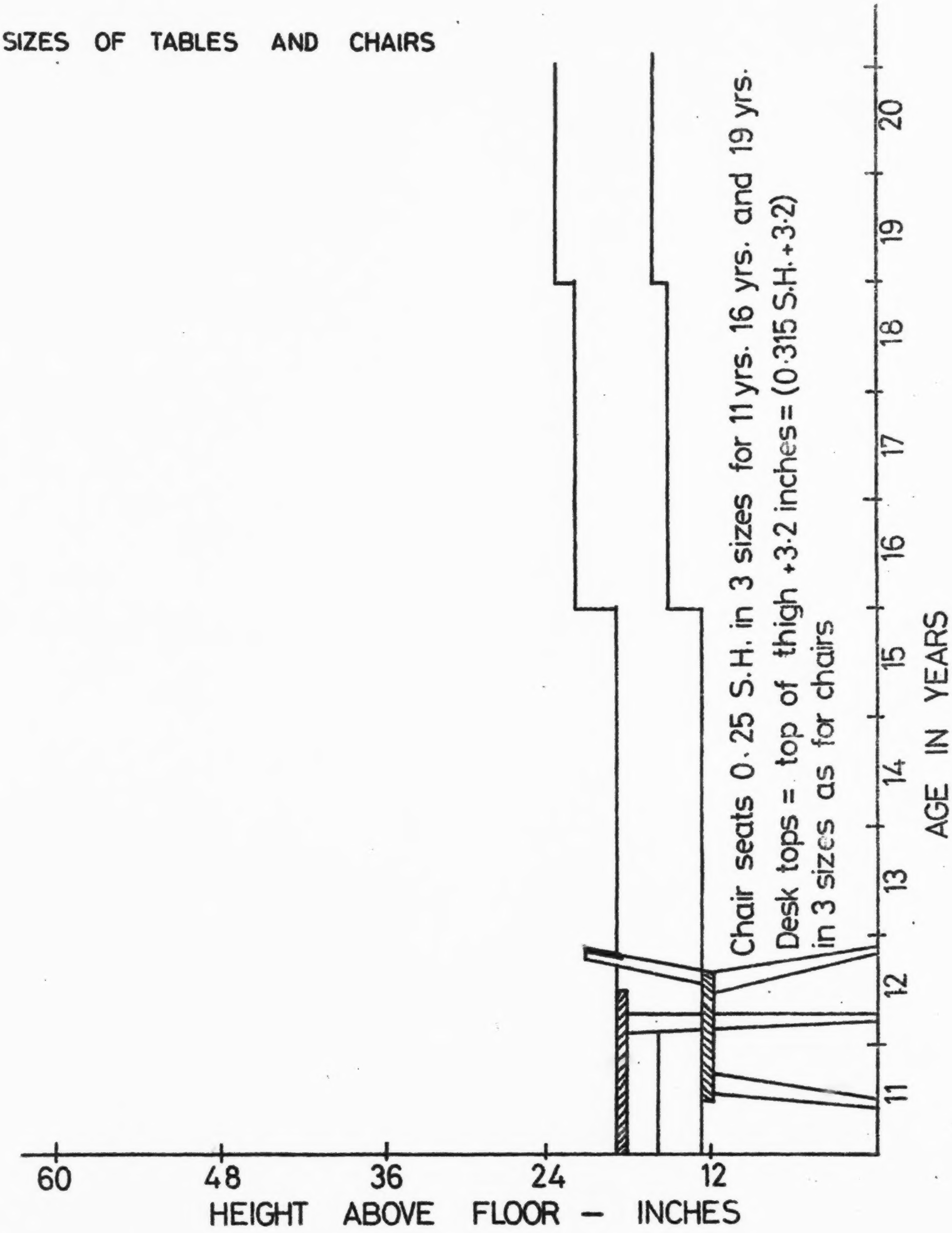
Possible example for
2nd level school
age range 11+ Adjust.
if age range less



ANNEXURE III

BODY SIZES

SIZES OF TABLES AND CHAIRS



ANNEXURE III

BODY SIZES

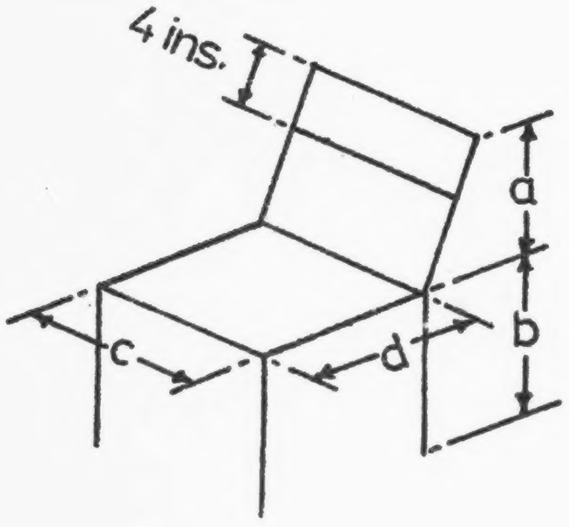
SIZES OF INDIVIDUAL CHAIRS AND DESKS

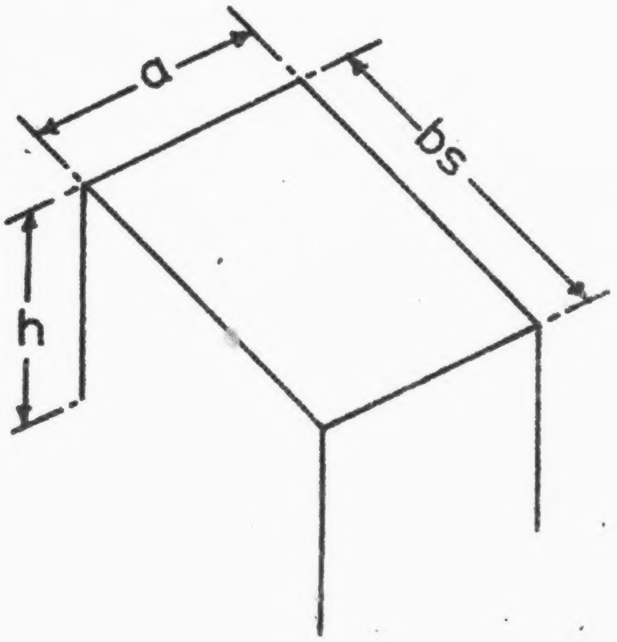
CHAIRS

SIZE	a	b	c	d
11-15 yrs	11 ins.	12.5 ins.	11 ins.	10 ins.
16-18 yrs	11 ins.	15 ins.	13 ins.	12·2 ins.
19-20 yrs	11 ins.	16 ins.	13·8 ins.	13·1 ins.

DESKS

SIZE	a	bs
11-15 yrs	15 ins.	19 ins.
16-18 yrs	18 ins.	22·8 ins.
19-20 yrs	19·2 ins.	24·3 ins.





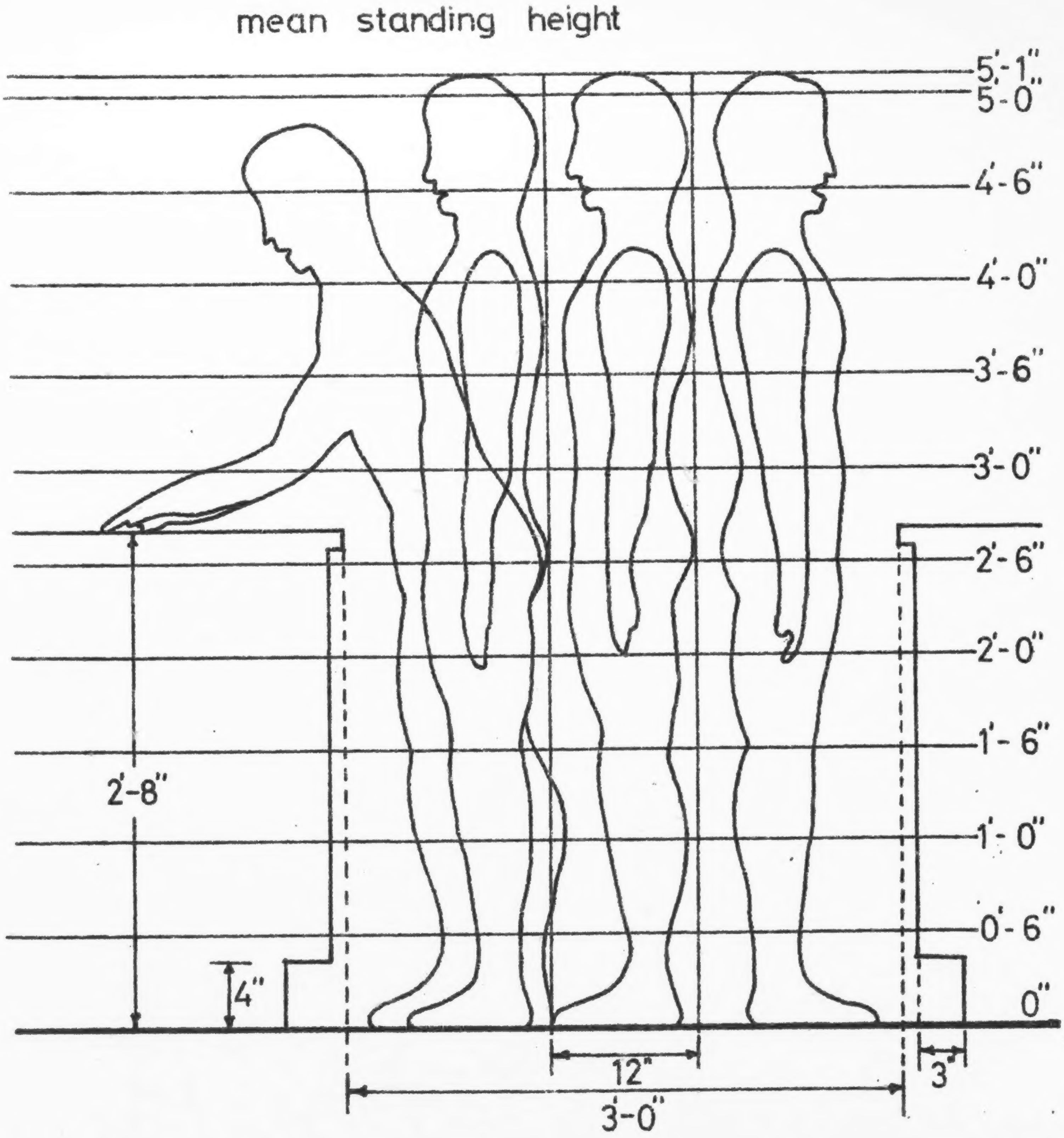
b = (0·25 S·H·)
c = (0·2 S·H·+1)
d = (0·22 S·H·−1)
} chairs

desks { a = (0·30 S.H.)●
bs = (0·38 S·H·)

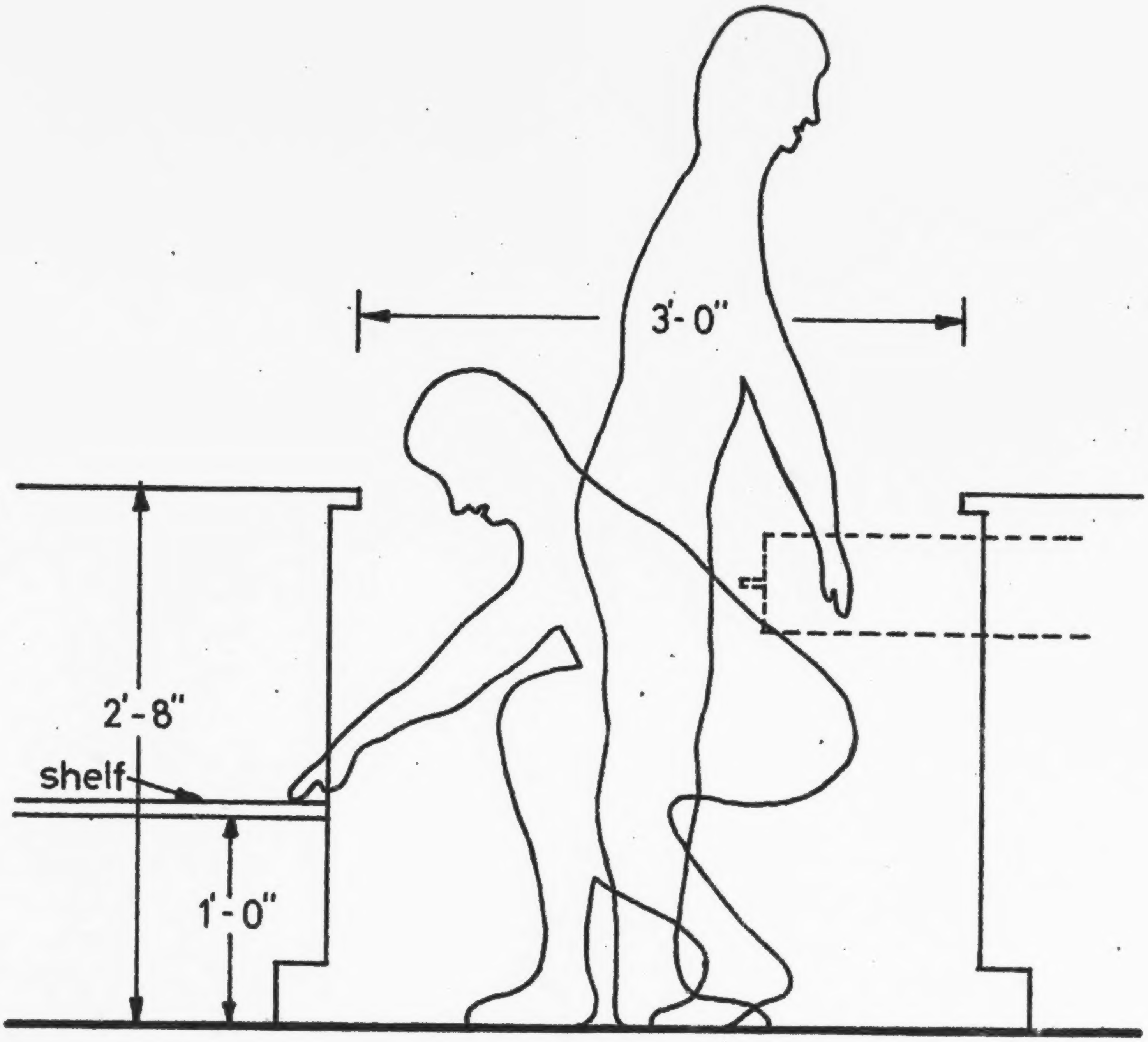
● 0·25 S·H· space for ink well etc.

ANNEXURE III

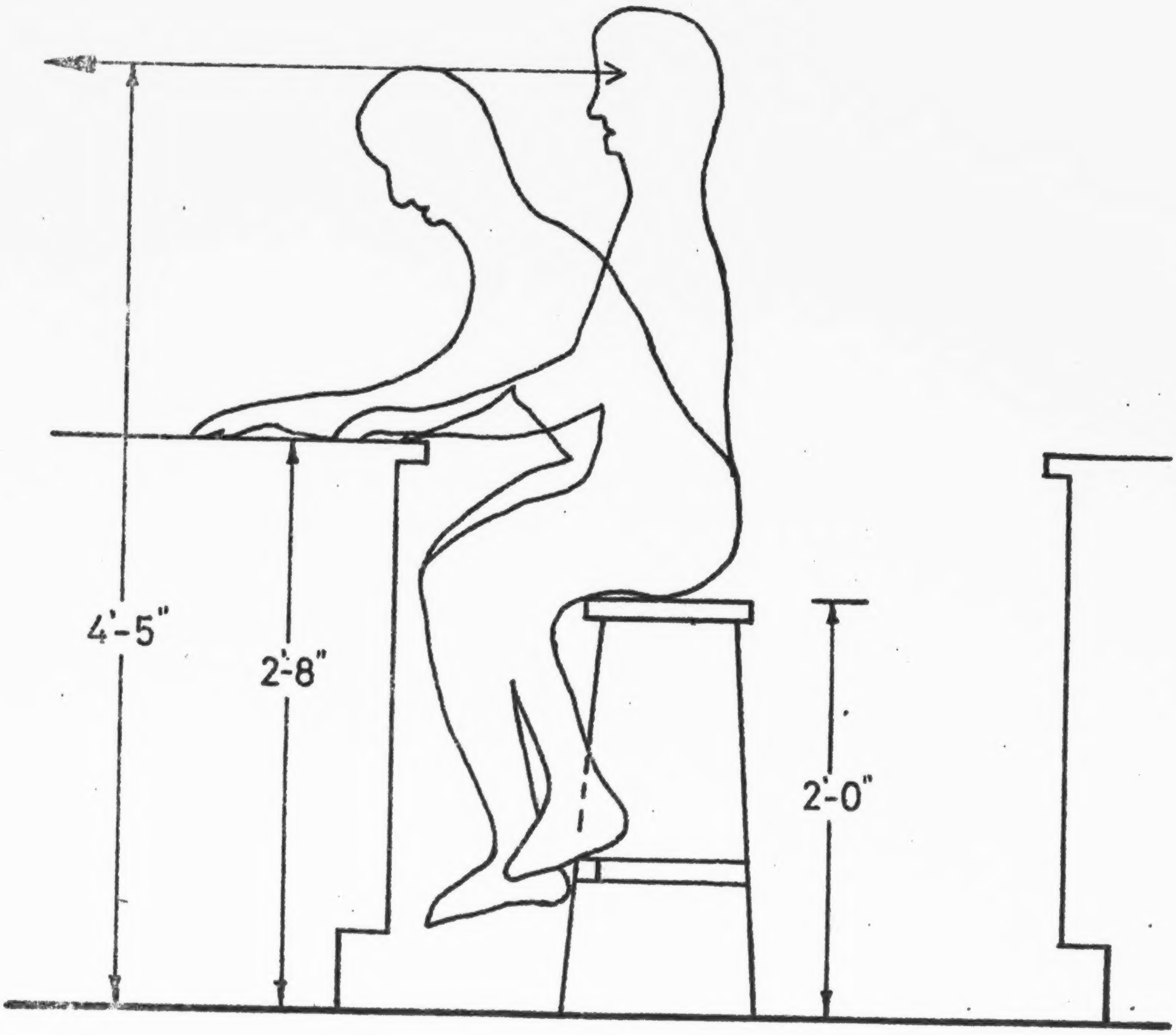
SPACING BETWEEN BENCHES


mean standing height
5'-1"
5'-0"
4'-6"
4'-0"
3'-6"
3'-0"
2'-6"
2'-0"
1'-6"
1'-0"
0'-6"
0"
2'-8"
4"
12"
3'-0"
3"

ANNEXURE III


3'- 0"
2'-8"
shelf
1'- 0"

ANNEXURE III



ANNEXURE III

ANNEXURE IV

MEAN MAX. EQUATORIAL COMFORT INDICES - CEYLON

Station	Mean Max. Temp °F	Month	Mean Max Wet Bulb °F	Equatorial comfort index F°	
				Zero wind speed	Wind speed 300 F pm
Colombo	94.9	Feb.	78.1	81.0	78.0
Katunayake	95.6	Feb./Mar.	79.3	82.0	78.5
Puttalam	90.6	April	81.3	83.0	79.5
Mannar	93.6	April	81.6	83.0	79.0
Jaffna	92.2	May	82.2	83.5	79.0
Kankesanturai	96.8	May	81.8	83.5	79.5
Trincomalee	98.6	June	80.0	82.5	79.0
Batticaloa	97.5	July	79.6	82.0	78.5
Hambantota	93.5	July	78.6	81.0	78.0
Galle	90.5	Feb.	77.9	80.0	77.0
Ratmalana	93.8	Feb.	78.4	81.0	78.0
Ratnapura	97.9	Mar.	79.8	82.0	79.0
Anuradhapura	97.3	Aug.	77.6	81.0	78.0
Vavuniya	98.8	Aug.	77.8	81.0	78.0
Kurunegala	96.8	Apr.	80.2	82.5	79.0
Maha Illupallama	96.6	Aug.	76.9	80.5	78.0
Kandy	91.8	Mar.	75.4	79.0	76.0
Badulla	91.3	July	74.0	78.5	76.0
Diyatalawa	84.0	June	68.4	75.0	75.0
Nuwara Eliya	78.9	Apr.	66.9	75.0	75.0

At an equatorial comfort index of 78°F the largest number of people will feel thermally comfortable. At 70° every one will feel too cold and at 85°F every one will feel uncomfortably hot.

The table makes the need for breeze in buildings very apparent as in most cases, with a good breeze blowing the index is reduced from 80°F to about 78°F, At higher elevations, room temperatures tend to be too low.